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Part II

Environmental Protection Agency

1981 Model Year Light-Duty Vehicle Carbon Monoxide (CO) Emissions; Revised Standards and Applications for Waiver of Effective Date

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 86

[FRL 1508-6]

Revised Motor Vehicle Exhaust Emission Standards for Carbon Monoxide (CO) for 1981 Model Year Light-Duty Vehicles

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: This regulation established CO emission standards for 1981 model year light-duty vehicles belonging to certain Ford Motor Company (Ford) engine families for which I have granted waivers from the standard otherwise applicable under section 202(b)(5) of the Clean Air Act, 42 U.S.C. 7521(b)(5). This regulation also includes technical corrections to rules accompanying previous CO waiver decisions.

EFFECTIVE DATE: July 14, 1980.

FOR FURTHER INFORMATION CONTACT: Mr. Alex Varela, Manufacturers Operations Division (EN-340), U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460, (202) 472-9421.

PUBLIC DOCKET: Information relevant to this rule is contained in Public Docket EN-80-1 at the Central Docket Section of the Environmental Protection Agency (EPA), Room 2903 B, 401 M Street, S.W., Washington, D.C. 20460 and is available for review between the hours of 8:00 a.m. and 4:00 p.m. As provided in 40 CFR Part 2, a reasonable fee may be charged for copying services.

SUPPLEMENTARY INFORMATION: Section 202(b)(1)(A) of the Clean Air Act ("the Act"), 42 U.S.C. 7521(b)(1)(A), requires that regulations applicable to CO emissions from light-duty vehicles or engines manufactured during or after the 1981 model year shall contain standards which require a reduction of at least 90 percent from CO emission levels allowable under the 1970 model year standards. Regulations implementing this requirement have established a CO standard, often referred to as the statutory standard for CO, of 3.4 grams per vehicle mile (gpm).

Section 202(b)(5) of the Act authorizes the Administrator, on application of any manufacturer, to waive the statutory CO standard for the 1981 and 1982 model years for any light-duty vehicle model regarding which the Administrator can make certain findings. In these cases, the Act requires that I promulgate substitute CO standards for 1981 and 1982 model year light-duty vehicles as discussed below. Applications for waivers considered here were submitted by Ford Motor Company (Ford), and General Motors Corporation (GM). The statutory criteria, my determinations regarding the criteria with respect to the vehicle models covered by the waiver applications, and my decisions to grant or deny the waiver applications appear in the consolidated decision along with this rule and published elsewhere in this issue of the **Federal Register**. In that consolidated decision, I granted waivers covering the following vehicle models (engine families for purposes of that decision) for the 1981 model year only:

Manufacturer and engine family

Ford Moter Company—1.3L, 1.6L/2 venturi, overhead camshaft.

Once I have decided to grant waiver applications for these two 1981 model year vehicle models, the Act requires that I simultaneously promulgate regulations adopting emission standards not permitting CO emissions from 1981 model year vehicles of these Ford models to exceed 7.0 gpm. Moreover, the Act further requires that I promulgate regulations establishing these standards no later than 60 days after I receive the waiver application in question. The public has been afforded an opportunity to comment on the waiver applications at issue, and I have considered those comments in making the consolidated decision which requires the promulgation of this amended rule.

In addition, this amended rule corrects the designation of two BL Cars, Ltd. engine families which have received waivers and were mislabeled in the rule first published in conjunction with my first consolidated CO waiver decision. This amended rule also reorganizes the most recent version of the regulatory provision, published at 45 FR 17914 (March 19, 1980), to make it consistent with another prior version of the provision, published at 45 FR 14496 (March 5, 1980). These corrections are merely technical in nature.

For these reasons, I find that providing notice and an opportunity to comment before final promulgation of any of the amendments contained in this rulemaking is impracticable and unnecessary.

Note.—The Environmental Protection Agency has determined that this document does not contain a major proposal requiring preparation of a regulatory analysis under Executive Orders 11821 and 12044 and OMB Circular A-107.

In addition, because the decision accompanying this rulemaking already is based on a detailed analysis indicating that this rulemaking will have a negligible effect on air quality, the Environmental Protection Agency has not prepared an Environmental Impact Statement to accompany this rulemaking as well.

Dated: May 30, 1980.

Douglas M. Costle,

Administrator.

40 CFR Part 86 is amended as follows:

Subpart A—General Provisions for Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles, 1977 and Later Model Year New Light-Duty Trucks and 1977 and Later Motor Year New Heavy-Duty Engines

1. 40 CFR 86.081-8(a)(1)(ii) is revised to read as follows:

§ 86.081-8 Emissions standards for 1981 light-duty vehicles.

(a)(1) * * *

(i) * * *

(ii) Carbon monoxide-3.4 grams per vehicle mile (2.11 grams per vehicle kilometer), except that carbon monoxide emissions from light-duty vehicles of the following 1981 model year engine families shall not exceed 7.0 grams per vehicle mile (4.35 grams per vehicle kilometer):

Manufacturer and Engine Family

American Motors Corporation—151 CID, 258 CID.
BL Cars, Ltd.—215 CID, 326 CID.
Chrysler Corporation—1.7 liter, 2.2 liter, 2.6 liter, 3.7 liter, 5.2 liter/2-V, 5.2 liter/4-V.
Ford Motor Company—1.3 liter, 1.6 liter/2V overhead camshaft.
General Motors Corporation—2.8 liter/173 CID-2V, 3.8 liter/231 CID-2V, 3.8 liter/231 CID-4V turbo.
Lotus Cars, Ltd.—2.0 liter.
Toyo Kogyo Co., Ltd.—91 CID, 120 CID.
Toyota Motor Company, Ltd.—88.6 CID.

* * * * *

2. Section 86.082-8(a)(1)(ii) is revised to read as follows:

§ 86.082-8 Emission standards for 1982 light-duty vehicles.

(a)(1) * * *

(i) * * *

(ii) Carbon monoxide. 3.4 grams per vehicle mile (2.11 grams per vehicle kilometer), except that carbon monoxide emissions from light-duty vehicles of the following 1982 model year engine families shall not exceed 7.0 grams per vehicle mile (4.35 grams per vehicle kilometer):

Manufacturer and engine family

American Motors Corp.—258 CID.
BL Cars, Ltd.—215 CID, 326 CID.
Chrysler Corp.—1.7 liter, 3.7 liter, 5.2 liter/4-V.
General Motors Corps.—2.8 liter/173 CID-2V, 3.8 liter/231 CID-2V.
Toyota Motor Co., Ltd.—88.6 CID.

* * * * *

(Sections 202 and 301(a) of the Clean Air Act, as amended, 42 U.S.C. 7521 and 7501(a))

[FR Doc. 80-17365 Filed 6-11-80; 8:45 am]

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ENVIRONMENTAL PROTECTION AGENCY

[FRL 1508-7]

Applications for Waiver of Effective Date of the 1981 Model Year Carbon Monoxide Emission Standard for Light-Duty Motor Vehicles—Sixth Consolidated Decision of the Administrator

I. Introduction

This is the sixth consolidated decision I have issued under Section 202(b)(5) of the Clean Air Act, as amended (Act), 42 U.S.C. 7521(b)(5), regarding applications from automobile manufacturers for waiver of the 3.4 grams per vehicle mile (gpm) carbon monoxide (CO) emission standard scheduled to apply to 1981 and 1982 model year light-duty motor vehicles and engines.[1]

As the introductions to the previous consolidated decisions explain, section 202(b)(1)(A) of the amended Act establishes a schedule for implementing standards applicable to CO emissions for 1977 and later model year light-duty motor vehicles and engines.[2] The 1977 amendments to the Act, however, included a new provision allowing the Administrator of the Environmental Protection Agency (EPA), under certain limited conditions, to delay for up to two model years implementation of the statutory 3.4 gpm CO standard scheduled to take effect for the 1981 model year.[3] However, these amendments require the Administrator to promulgate standards for vehicles granted waivers which do not permit CO emissions over 7.0 gpm.[4]

In response to waiver applications, EPA already has held four sets of public hearings and issued five consolidated decisions pursuant to section 202(b)(5)(A).[5] In those decisions, I denied waivers for certain engine families either because I determined that effective control technology[6] was available contrary to the requirement of section 202(b)(5)(C)(iii) of the Act or because the applicant failed to provide sufficient information to establish that effective control technology was not available. Furthermore, the applicants failed to establish that considerations of costs, driveability, or fuel economy gave me a basis for reaching a different conclusion. I granted the waiver applications covering the remaining engine families after determining for each of those families that the requisite technology was not available, considering costs, driveability, and fuel economy, and that each application met all of the remaining statutory criteria for receiving a waiver.

From January 8 through February 8, 1980, EPA received waiver applications from Renault, Peugeot, Ford and GM.[7] Specifically, Peugeot and Ford submitted new applications, while GM and Renault requested waivers for engine families denied waivers in the first[8] and second[9] consolidated decisions. EPA held hearings on these applications on February 12, 1980.[10]

This decision will address only the waiver requests from Ford and GM on the basis of previously offered and recently provided information from these manufacturers and from other sources.[11] I have addressed the waiver requests by Peugeot and Renault in a previous consolidated decision.[12]

II. Summary of Decision

I am granting Ford's waiver requests for its 1.3 liter (L) and 1.6L/2 venturi(V) overhead camshaft (OHC) engine families for only the 1981 model year. I am denying GM's waiver requests covering its 4.9L/4V turbocharged engine family for the 1981 and 1982 model years and Ford's waiver requests for its 1.3L and 1.6L/2V OHC engine families for the 1982 model year. As with previous waiver decisions, my determinations here were based primarily upon whether the applicant established that effective emissions control technology, considering costs, driveability, and fuel economy, was available to enable the engine family in question to meet the 3.4 gpm statutory CO standard for the 1981 and 1982 model years.

I have concluded that waiver applications covering the Ford 1.3L and 1.6L engine families meet each of the statutory criteria for receiving a waiver for the 1981 model year. I am therefore prescribing an interim CO emission standard of 7.0 gpm for the 1981 model year for these engine families.

GM failed to establish that effective control technology is unavailable to enable its 4.9L/4V turbocharged engine family to meet the statutory CO standard by the 1981 model year. Instead, the information in the record at this time indicates that such technology is available for this engine family. In addition, Ford has failed to provide information sufficient to establish that effective control technology is not available for its 1.3L and 1.6L/2V OHC engine families for the 1982 model year. Considerations of costs, driveability, or fuel economy, whether viewed

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[1] The preceding decisions were published as follows: 44 FR 53376 (September 13, 1979); 44 FR 69417 (December 3, 1979); 45 FR 7122 (January 31, 1980); 45 FR 17914 (March 19, 1980); FR (signed May 14, 1980).

[2] Regulations were promulgated on August 15, 1979, setting a CO standard of 3.4 gpm for 1981 and later model year vehicles. 40 CFR 86.081-8(a)(1)(ii), 44 FR 37972. This standard requires at least a 90 percent reduction in CO emissions from the CO standard applicable to 1970 model year vehicles.

[3] Section 202(b)(5)(C) of the Act provides, in part: The Administrator may grant such waiver if he finds that protection of the public health does not require attainment of such 90 percent reduction for carbon monoxide for the model years to which such waiver applies in the case of such vehicles and engines and if he determines that—

(i) such waiver is essential to the public interest or the public health and welfare of the United States;

(ii) all good faith efforts have been made to meet the standards established by this subsection;

(iii) the applicant has established that effective control technology, processes, operating methods, or other alternatives are not available or have not been available with respect to the model in question for a sufficient period of time to achieve compliance prior to the effective date of such standards, taking into consideration costs, driveability, and fuel economy; and

(iv) studies and investigations of the National Academy of Sciences conducted pursuant to subsection (c) and other information available to him has not indicated that technology, processes, or other alternatives are available (within the meaning of clause (iii)) to meet such standards.

[4] As noted in previous decisions, Section 202(b)(5) of the Act requires that I make a separate assessment for each vehicle model covered by a waiver request. See, e.g., 44 FR 53376 (September 13, 1979); 44 FR 69416 (December 3, 1979); and 45 FR 7122 (January 31, 1980). Thus, these earlier consolidated decisions have included separate decisions for individual engine families. As in the previous decisions, I have distinguished among engine familes primarily on the basis of engine displacement. See footnote 17, second consolidated decision, 44 FR 69416, 69418 (December 3, 1979).

[5] I announced the fourth decision, in response to a consolidated waiver application by Chrysler, separately from the decision on applications by other manufacturers considered at the third hearing. 45 FR 17914 (March 19, 1980). EPA has included testimony received at these three hearings, as well as all other information considered in deciding these three groups of waiver applications, in EPA Public Dockets EN-79-4, EN-79-17, and EN-79-19, respectively. In addition, this decision incorporates by reference the record of the U.S. Environmental Protection Agency Hearings In the Matter of Proposed High Altitude Emission Standards, Region 8, March 5, 1980.

[6] As was the case in the earlier consolidated decisions, I am using the term "technology" in this decision to encompass the statutory language "technology, processes, operating methods, or other alternatives" included as part of section 202(b)(5)(C)(iii) of the Act.

[7] Respectively, Regie Nationale Des Usines Renault; Automobiles Peugeot; Ford Motor Company and General Motors Corporation.

[8] 44 FR 53376 (September 13, 1979), GM.

[9] 44 FR 69416 (December 3, 1979), Renault.

[10] The transcript from this hearing is located in EPA Public Docket EN-80-1. This decision uses the following abbreviations:

F. App.—Ford Application for CO Waiver, dated February 8, 1980.

GM Reapp.—GM Application for CO Waiver, dated February 8, 1980.

[11] See the discussion on my consideration of other sources of information in the previous waiver decisions, e.g. section III(B)(1)(C), 44 FR 69416, 69422 (December 3, 1979).

[12] FR (signed May 14, 1980).

separately or cumulatively, do not give me a basis for altering my determinations regarding the availability of technology for these engine families.

While these engine families may meet some, or all, of the remaining statutory criteria for receiving waivers, my determinations regarding available technology, considering costs, driveability, and fuel economy, preclude me from granting waivers covering these engine families for the model years which I have specified. The 3.4 gpm CO statutory standard will therefore remain in effect for the GM 4.9L/4V turbocharged engine family for the 1981 and 1982 model years and for the Ford 1.3L and 1.6L/2V OHC engine families for the 1982 model year.

III. Discussion

A. *Availability of Technology.* The decisions I have made here on whether to grant or deny requested waivers turn primarily on whether technology is available to enable an engine family covered by one of these waiver applications to meet the 3.4 gpm CO standard in the 1981 model year. Section 202(b)(5)(C)(iii) of the Act expressly assigns an applicant the task of establishing that effective CO control technology is not available, taking into consideration costs, driveability, and fuel economy. Even if the Administrator determined that an applicant has met this burden, section 202(b)(5)(C)(iv) requires that Administrator to consider whether NAS studies or other information indicate that technology is available, considering costs, driveability, and fuel economy, before granting a waiver request.

As was the case in the previous consolidated CO waiver decisions, this consolidated decision relies on information contained in the waiver applications and other information found in the public record.[13]

As part of my assessment of technology, I have considered the results of NAS studies and investigations [14] conducted under section 202(c) of the Act regarding available technology, processes, or other alternatives. For the reasons discussed in my earlier consolidated waiver decisions, the findings of the available NAS studies do not contradict my assessment regarding the availability of technology for these two engine families.[15]

To support contentions that effective control technology is not available, the waiver applicants have provided both descriptions of the systems they have been considering in trying to attain the 3.4 gpm CO emission standard and the results of emission tests performed on vehicles for the purpose of receiving certification. I have reviewed this information, as well as other information available to me, in reaching my decisions regarding availability of the requisite technology, considering costs, driveability and fuel economy.

1. *GM.* GM requested reconsideration of my earlier decision denying its application for a CO waiver for the 4.9L/4V turbocharged engine family for the 1981 and 1982 model years. I denied GM's previous waiver request because I determined that GM failed to provide sufficient information to establish that effective technology was not available.[16]

On February 8, 1980, GM reapplied for a waiver of the 3.4 gpm CO standard for the 4.9L/4V turbocharged engine family for the 1981 and 1982 model years. As part of its reapplication, GM submitted additional, newly available emission test data and further technical information. GM asserted generally that this information now establishes that technology is unavailable at this time to enable this engine family to meet a 3.4 gpm CO standard.

Specifically, GM stated that it is unable to incorporate emission control technology that would enable this engine family to meet the 3.4 gpm CO standard because of space constraints and temperature control problems related to the location of the turbocharger in the exhaust line.[17]

After reviewing GM's submission, I have determined that GM still has failed to establish that effective emission control technology, considering costs, driveability, and fuel economy, is not available to enable its 4.9L/4V turbocharged engine family to meet the 3.4 gpm CO standard for the 1981 and 1982 model years. In reaching this decision, I have concluded that this engine family is capable of meeting the 3.4 gpm CO standard without the addition of any components or adjustments to the available 1981 engine emission control system.[18]

Appendix A applies to extended-mileage certification emission data from GM's 4.9L/4V turbocharged certification "durability" vehicles a "Modified" Monte Carlo statistical simulation technique to protect the likelihood that a given engine family will be capable of certifying to applicable emission standards. This technique is similar to the "standard" Monte Carlo simulation technique used in previous suspension and waiver decisions and identical to that used in my fifth consolidated decision on Renault's 85 CID engine family.[19] The standard Monte Carlo technique applied in my first three consolidated waiver decisions included consideration of certain variabilities in projecting the likelihood of successful certification on the basis of emissions data from pre-production development vehicles.[20] Because data from actual certification test vehicles are now available for the 1981 model year 4.9L/4V turbocharged engine family, certain terms which in previous decisions had been incorporated in the standard Monte Carlo simulation to account for variabilities in emissions performance are no longer relevant.[21] EPA has therefore modified the Monte Carlo simulation technique used in the first three consolidated CO decisions by eliminating those variabilities which are no longer applicable when evaluating actual certification data.[22]

This Modified Monte Carlo analysis indicates with a high degree of statistical confidence that GM's 4.9L/4V turbocharged engine family, even with no improvements to its emissions control system, is capable of certification at the 3.4 gpm CO standard for the 1981 and 1982 model years. This Modified Monte Carlo analysis thus indicates that effective emissions control technology is available for the GM engine family.[23]

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[13] Much of this information was gathered for and included in the record for the previous consolidated CO waiver decisions. See EPA Public Dockets EN-79-4, EN-799-17, and EN-79-19. Those records have been incorporated by reference into the record for this fifth consolidated decision, EPA Public Docket EN-80-1.

[14] Report by the Committee on Motor Vehicle Emissions of the National Academy of Sciences, dated November, 1974. See also discussions of the applicability of NAS studies in previous CO waiver decisions, e.g., 44 FR at 53376, 53386 (September 13, 1979) and 44 FR at 69416, 69423, 69428 (December 3, 1979).

[15] See, e.g. 44 FR 53376, 53386 (September 13, 1979); 44 FR 69416, 69428 (December 3, 1979).

[16] 44 FR 53376 (September 13, 1979).

[17] GM Reapp., pp. 1-2. February 12, 1980 Transcript, pp. 188, 207-211, 217.

[18] Cf. my previous denial of this engine family, based on insufficient emissions test data. 44 FR 53376 (Sept. 13, 1979). See also App. A, Section V.

[19] — FR — (signed May 14, 1980).

[20] See, e.g., notes 21-23 — FR —, (signed May 14, 1980).

[21] App. A, Section III.

[22] For a detailed comparison between the standard and modified Monte Carlo simulation techniques, see — FR — (signed May 14, 1980). This decision also includes analysis of emissions data through the full 50,000 miles of certification testing. See App. A sections III, V.

[23] The first vehicles GM started in EPA's extended-mileage certification "durability" test marginaly failed the Modified Monte Carlo analysis applied to the certification emissions data available here. However, a later-starting GM certification vehicle (vehicle 1264) which included some emission control improvements easily passed the modified Monte Carlo analysis. App. A, section V.

In addition to the Modified Monte Carlo analysis available certification test results on GM's vehicle 1260 also demonstrate the ability of GM's 4.9L/4V turbocharged engine family to complete certification testing successfully through 50,000 miles.[24] Thus, with the 50,000-mile certification testing complete, available certification data confirm that the turbocharged version of this engine can pass certification at a level comfortably below the 3.4 gpm CO standard.

Consideration of costs, driveability, or fuel economy offers no basis for altering my conclusion that GM has failed to establish emissions control technology is not available for its 4.9L/4V turbocharged engine family.[25] Since the engine family/emissions control system for which GM has requested the waiver is the same system which has currently passed 1981 certification at the 3.4 gpm CO level, GM has not demonstrated any cost, driveability or fuel economy differentials between a system it plans to use under a 7.0 gpm CO standard and one targeted to meet the 3.4 gpm CO standard.

Other technology also is available to enable vehicles scheduled to use this engine family to meet the 3.4 gpm CO emissions standard. Specifically, GM acknowledged that the naturally aspirated version of this engine, which is capable of meeting the 3.4 gpm CO standard,[26] is available for the 1981 model year and could be substituted in all vehicles which GM has scheduled to use the turbocharged version of the 4.9L/4V engine.[27]

In this case, the information from GM only indicated some performance difference between the 4.9L/4V turbocharged version and the 4.9L/4V naturally aspirated version.[28] These potential performance effects which GM has raised, however, do not give me a basis for concluding that the naturally aspirated version of this engine does not constitute available effective control technology, considering costs, driveability, and fuel economy.[29]

2. *Ford.* Ford applied for waivers for its 1.3L and 1.6L/2V OHC. engine families for the 1981 and 1982 model years. In support of this application, Ford provided some emission test data and other information regarding development of alternative emissions control systems. Ford contended that (1) effective emission control technology was not available to enable these engine families to meet a 3.4 gpm CO standard for the 1981 and 1982 model years; and (2) lead time problems prevented the introduction of alternative emissions control systems or components at this late period in Ford's production schedule.[30] Specifically, Ford claims[31] that unanticipated problems primarily associated with catalyst degradation and EGR system plugging prevent these engines families from certifying under the 1981 statutory emissions standards for the 50,000-mile statutory period.[32]

I have determined that Ford has established that effective emission control technology, considering costs, driveability, and fuel economy, is not available to enable its 1.3L and 1.6L/V OHC engine families to meet a 3.4 gpm CO emission standard for the 1981 model year, I have also concluded, however, that Ford has failed to establish that such technology will not be available to enable these engine families to meet the 3.4 gpm CO standard in the 1982 model year.

My evaluation of the technological capability of these Ford engine families is based upon the same Modified Monte Carlo statistical simulation employed in evaluating the GM 4.9L/4V turbocharged engine family and the Renault 85 CID engine family in my fifth consolidated decision.[33] In addition, my evaluation is based on certification data from vehicles that have completed the mandatory 50,000 mile certification testing procedure. Appendix A applies this Modified Monte Carlo statistical simulation technique to actual certification emission data from Ford's 1.3L and 1.6L/2V OHC certification vehicles.

Not one 1.6L/2V OHC vehicle demonstrated the capability to meet the 3.4 gpm CO standard, either under the Modified Monte Carlo analysis or through 50,000 miles of durability certification testing. As a result, I have determined that Ford has established that effective control technology is not available for this engine family.

One Ford 1.3L test vehicle, number 002, did demonstrate the ability to meet the 3.4 gpm CO standard after completing 50,000 miles of durability testing.[34] However, vehicle 002 was subjected to fairly extensive unscheduled maintenance and emission component replacement during the 50,000 mile test. This has raised concern as to whether vehicle 002 should be accepted as a durability data vehicle for purposes of either certification or the CO waiver. It may not be representative of the durability of emissions control components that vehicles of this engine family will actually exhibit in use, because such corrective maintenance and component replacement is not likely to be performed by vehicle owners in use.

Even if EPA accepted the durability testing data from vehicle 002 for certification purposes on the basis that the problems were being remedied, there remains the risk that basing waiver denial on the emissions performance of vehicle 002 would exacerbate the problems exhibited by vehicles in this engine family. Catalyst problems encountered during certification testing of vehicles in the 1.3L engine family indicate that vehicles in this engine family may exhibit catalyst degradation in actual operation during the useful life of the vehicles if required to meet the 3.4 gpm CO standard.[35] Even though vehicle 002 itself did not encounter identical difficulties, technical analysis of the vehicles with similar engine/emission control systems indicates that a significant risk exists that the catalyst problems would continue to occur in use.[36] Such catalyst degradation in use is likely to result in CO emissions at levels substantially higher than 3.4 gpm or even 7.0 gpm.[37] The least stringent CO standard I may impose during the waiver period is 7.0 gpm.

If the catalysts do experience significant degradation in use, the only

[24] App. A, section V.

[25] App. A, sections, VI, VII, VIII.

[26] The naturally aspirated version of this engine has completed certification "durability" testing under the 3.4 gpm CO standard. App. A, section V. February 12, 1980 Transcript, p. 204.

[27] February 12, 1980 Transcript, p. 205; App. A section V; GM supplemental submission, February 25, 1980, p. 4.

[28] GM stated, for example, that acceleration from 0 to 60 mph is approximately two and one half seconds faster with a turbocharged version than with a naturally aspirated version in the same vehicle. The turbocharged version also has better passing performance than a similar naturally aspirated version. The decrease in performance with a naturally aspirated version, however, is not significant enough to cause driveability problems. February 12, 1980 Transcript, pp. 248, 249.

[29] Cf. my decision on the Volkswagen 97 CID/FBC engine family. 44 FR 53376, 53385, 53387, 53388 (Sept. 13, 1979). In fact, GM stated that the naturally aspirated version of the 4.9L/4V engine family achieves better fuel economy than the 4.9L/4V turbocharged version. February 25, 1980 GM submission, p. 10. GM did not contend that the turbocharged version of this engine held any cost or driveability advantages over the naturally aspirated version.

[30] February 12, 1980 Transcript, pp. 112, 132, 138; Ford supplemental submission, March 19, 1980, p. 2.

[31] Ford App., section 3–B; App. A, section V; February 12, 1980 Transcript, pp. 124, 125, 128, 131.

[32] 42 U.S.C. 7521(d)(1)(1977).

[33] — FR — (Signed May 14, 1980).

[34] All other 1.3L engine family test vehicles for which Ford submitted emission test data failed to demonstrate the capability of meeting the 3.4 gpm CO standard. App. A, section V.

[35] Vehicles in the 1.6L/2V engine family also exhibited catalyst degradation. App. A, section V. The "useful life" of light-duty vehicles is five years or fifty thousand miles, whichever first occurs. 42 U.S.C. 7521(d)(1)(1977) and 40 C.F.R. 86.077–2.

[36] App. A, section V.

[37] App. A, section V.

way that the vehicles would be able to continue meeting a 3.4 gpm CO standard is by replacing the catalyst before its efficiency deteriorates excessively. Emissions control technology requiring catalyst replacement is unlikely to be effective in controlling emissions to the 3.4 gpm CO level, however, because it requires consumers to assume a substantial burden in ensuring that these engine families continue to meet the CO standard. Specifically, this would require consumers to be aware of the fact that their catalyst requires replacement, and then to assume additional costs or additional inconvenience (leaving a car for repairs), both of which there is a natural inclination to avoid.[38] Failing to perform the necessary repair or replacement of a catalyst which has experienced degradation probably would result in continuous emissions of CO at levels which could be well above the levels that would be produced under a 7.0 gpm standard.

Ford has indicated that it will attempt to eliminate its catalyst degradation problems by employing combined carburetor/secondary air management system changes which would produce CO emissions levels that most probably would exceed the 3.4 gpm standard. A 7.0 gpm CO standard could enable Ford to incorporate such a system and increase the likelihood that Ford will be able to correct its catalyst degradation problems without violating that standard.[39] As discussed in the public health and welfare discussion in section III C of this decision, the possibility that higher CO emission levels resulting from consumer failure to replace catalysts that have experienced significant degradation, poses potentially greater health risks than the higher emission levels that would result under a CO standard waived to 7.0 gpm.[40] My conclusion is based, in part, on the fact that the calibrations Ford could use to minimize catalyst degradation could be used only if the CO waiver were granted to a 7.0 gpm level.

Since test vehicles of the 1.3L engine family have not demonstrated satisfactorily that this engine family could meet the statutory CO standard without a significant risk of catalyst degradation during the useful life of the vehicles, I have concluded that Ford has established that effective control technology is not available for the 1.3L engine family to meet the 3.4 gpm CO standard in 1981.

Ford did not provide information sufficient to enable me to determine that effective emissions control technology would not be available for the 1982 model year to enable either the 1.3L or the 1.6L/2V OHC engine families to meet the 3.4 gpm CO emission standard. Additional technological alternatives for solving Ford's CO control problems are still available for Ford to evaluate and implement for 1982 model year vehicles of these engine families.[41] Ford did not supply sufficient information on these alternatives to demonstrate their effect on emissions from these two families.

Considerations of costs, driveability, or fuel economy, either separately or cumulatively, offer no basis for altering my conclusion that Ford has failed to establish that effective emissions control technology is not available for its 1.3L and 1.6L/2V OHC engine families for the 1982 model year.[42] Ford provided driveability information only for its 1.6L/2V OHC engine family. Although this driveability information indicated marginal driveability in some vehicles, Ford failed to establish that driveability would prove to be a problem in the 1982 model year.[43] Ford did not raise fuel economy as an issue and did not provide any information to support claims based upon this factor.

In addition, Ford has not established any cost differential between the system covered by this waiver request for a 7.0 gpm interim CO standard and a system it would need to meet the 3.4 gpm CO standard, because Ford has not indicated specifically what different technological alternatives it would consider using to improve the CO emissions of these engine families to meet the 3.4 gpm CO standard in the 1981 and 1982 model years or what the associated costs would be.

B. *Protection of Public Health.* Section 202(b)(5)(C) of the Act requires that before I grant a waiver covering a given engine family, I must find that protection of the public health does not require attainment of a 3.4 gpm CO standard by the vehicles of the engine family receiving the waiver. Thus, I have examined this issue with respect to Ford's 1.3L and 1.6L/2V OHC engine families for which I have determined that effective control technology, considering costs, driveability, and fuel economy, is not available in model year 1981. I have found as a result of this examination that any adverse health effects resulting from waiving the 3.4 standard for these 1981 model year engine families would be insignificant. The same statement is true regarding the combined health effects resulting from waiving the 3.4 standard for the 1981 model year for these engine families and for all the 1981 and 1982 model year engine families receiving waivers under the previous consolidated CO waiver decisions.[44] As a result, protection of the public health does not require attainment of the 3.4 gpm CO standard for the engine families for which I have determined that effective control technology is not available for the 1981 model year.[45]

According to the express terms of the statute, there is no need for me to determine whether waiver applications covering engine families for which applicants failed to establish the unavailability of effective control technology (considering costs, driveability, and fuel economy) meet any of the remaining statutory criteria in order for me to deny these applications.[46] The Act requires me to deny waiver applications where an applicant has failed to meet any one of the criteria, regardless of whether such applicant could meet the remaining criteria. Nevertheless, I will address these issues briefly in the course of discussing the remaining criteria in conjunction with those waiver

[38] See 44 FR 3360, 53361 (September 13, 1979).

[39] App. A, section V.

[40] In *International Harvester Co.* v. *Ruckelshaus*, the Court required EPA's Administrator, in deciding on a manufacturer's statutorily-authorized request for a delay in implementing more stringent emission standards, to consider the risk of any adverse environmental consequences which could raesult from denying that request. 478 F.2d 615,630 (D.C. Cir. 1973).

[41] App. A, section IX.

[42] App. A, sections VI, VII, and VIII.

[43] App. A, section VII.

[44] Moreover, in these cases waiver denials would give rise to a significant risk that the technology Ford has employed to enable these engine families to meet a 3.4 gpm CO standard will cause catalyst degradation, resulting in increased CO emissions above the levels that would be emitted under a 7.0 gpm standard. As previously stated, in section III A of this decision, there is a significant risk that the catalyst degradation would go unremedied in use. This risk outweighs the insignificant risk to public health which results from the slight increase in CO emissions from these engine families under granted waivers. Thus, by granting waivers and establishing a 7.0 gpm CO standard that will increase the likelihood that Ford can avoid its catalyst degradation problem, I can reduce the risk that vehicles in this engine family will experience significant degradation, and will emit levels of CO emissions well above the levels that they would emit under a 7.0 gpm standard.

[45] See e.g., the analysis of the effect of CO waivers on ambient air quality 44 FR 53376, 53402–53407 (September 13, 1979); and 44 FR 69416, 69456–69462 (December 3, 1979). The engine families receiving waivers under my previous CO waiver decisions only constitute approximately 20% of the total projected 1981 model year light-duty vehicle sales in the United States. Adding the engine families granted CO waivers here increases this figure to approximately 24%.

[46] These remaining criteria are found in Sections 202(b)(5)(C) of the Act. For discussion regarding these criteria in earlier waiver decisions, see, e.g., 44 FR 53376, 53378 (September 13, 1979); 44 FR 69416, 69420 (December 3, 1979); and 45 FR 7122, 7126 (January 31, 1980).

applications as I did in the five previous waiver decisions.

While waiving the 1981 and 1982 statutory CO standards for any of the engine families here would not significantly affect the public health, noticeable increases in ambient CO levels could result from granting waivers industry-wide.[47] In light of the fact that industry-wide waivers would not be protective of the public health, it is reasonable to grant waivers covering only that portion of the industry consisting of engine families for which I have determined that effective control technology, considering costs, driveability, and fuel economy, is not available (presuming these families also meet the remaining statutory criteria).[48]

C. *Essential to the Public Interest or to the Public Health and Welfare.* Before I may grant a waiver request, section 202(b) (5)(C)(i) of the Act requires that I determine that granting the waiver is essential to the public interest or the public health and welfare.

Ford asserted that granting the waiver requests for its 1.3L and 1.6L/2V OHC engine families is essential to the public interest to ensure Ford's ability to market these fuel-efficient vehicles and to avoid severe economic and social costs which could result from the failure to market these vehicles if a waiver were denied.[49] I have determined that granting one-year waivers to the two Ford engine families, for which I have determined that effective control technology is not available in the 1981 model year, is essential to the public interest. By granting these waivers, I will permit Ford to market two engine families which it otherwise most likely would not have been allowed to market because of their inability to certify. Granting waivers for this reason is essential to the public's interest in maintaining a diversified and competitive automotive industry for the United States market.[50]

I have determined that it is not essential to the public interest to grant waivers to the GM 4.9L/4V turbocharged engine family for the 1981 and 1982 model years, or to the Ford 1.3L and 1.6L/2V OHC engine families for the 1982 model year, because the applicants have failed to establish that these engine families are incapable of meeting a 3.4 gpm CO standard or are likely to incur significant costs (or driveability or fuel economy penalties) in meeting that standard for the model years in question.[51] Neither GM nor Ford established that technological problems, costs, or other penalties involved are so substantial as to present a significant risk in these cases to either waiver applicants' ability to produce and competitively market vehicles of these engine families, or vehicles generally.

GM contended that it is in the public interest to allow GM to market the specific technology represented by the 4.9L/4V engine family (turbocharging plus spark knock control).[52] In addition, GM claims that marketing this engine family is essential to the public interest because the turbocharger technology "allows a smaller engine to exhibit the performance capabilities of a larger engine * * * (and) granting this waiver request would provide for the additional accumulation of field experience with these technologies (turbocharging plus spark knock control)."[53]

This determination also applies to the situation presented by GM's waiver request even if GM's 4.9L/4V vehicles using GM's turbocharger technology for some unestablished reason cannot meet the 3.4 gpm standard. Because the 4.9L/4V naturally aspirated version of this engine family is a readily available alternative technology which is capable of meeting the 3.4 gpm CO emission standard, GM still would not have established that there is a significant risk to GM's ability to produce and market competitive vehicles scheduled for the 4.9L/4V turbocharged engine family, or vehicles generally.

If GM were to use the naturally-aspirated version of this engine, the only element of diversity which the United States market might lose is the asserted improvement in performance characteristics which the turbocharged technology potentially permits the GM vehicles in question to achieve. Otherwise, GM still can market these vehicles as planned. The Court in *International Harvester* recognized that the Act made clear that the need to achieve clean air objectives outweighs sacrifices that might result in the area of improved performance characteristics.[54] GM still will be able to market other vehicles using turbocharger and spark knock control technology, and thus gain field experience with this technology, in the 1981 model year.[55]

GM also contended that GM and the public would suffer significant adverse economic and social consequences were GM unable to market the 4.9L/4V turbocharged engine family.[56] However, because GM has not established that this engine family is incapable of complying with the 3.4 gpm CO emission standard, I find that there is no substantial risk that it will be unable to market the 4.9L/4V turbocharged engine family. In addition, GM claimed, but failed to establish, that it would suffer significant sales losses were GM to employ the 4.9L/4V naturally aspirated version of this engine in place of the 4.9L/4V turbocharged version in the vehicles in question.[57]

D. *Good Faith.* In order for me to grant a waiver to any applicant, section 202(b)(5)(C)(ii) of the Act requires that I determine that the applicant in question has made all good faith efforts to meet the established emission standards. As a result, I have examined information regarding each applicant's previous and projected efforts toward meeting a 3.4 gpm CO emission standard for the engine families in question.

Each of the waiver applicants has provided information to support the contention that it has acted in good faith in trying to meet the 3.4 gpm CO standard. In general, information in the record provides support for determining that each of the applicants has met the Act's good faith criterion in developing emission control technology to meet the 3.4 gpm CO standard.

Both of these applicants made only limited efforts to develop certain additional emissions control components which might be expected to

[47] Each of the applicants here has argued that granting a waiver to each of these engine families would have an insignificant impact on public health. For further discussion concerning these contentions, see the first decision, 44 FR 53376, 53381 and Appendix B at 44 FR 53402–53407 (September 13, 1979).

[48] See, e.g., 44 FR 53376, 53382, 53386–53387 (September 13, 1979).

[49] Ford App., section II–A.

[50] Additionally, by granting these waivers I can avoid giving rise to the potentially increased total CO emissions which could occur with suspect technology targeted to meet a 3.4 gpm standard and which could be well above the levels that would result under a 7.0 gpm standard. See section IIIC of this decision.

[51] This issue was discussed in the public interest analysis section in previous decisions regarding engine families denied waivers. See, e.g., 44 FR 53376, 53385 (September 13, 1979); 44 FR 69416, 69430 (December 3, 1979); 45 FR 7122 (January 31, 1980); and 45 FR 7914 (March 19, 1980). Appendix A contains a closer examination of the cost, driveability, and fuel economy issues. App. A, section V–IX. Previous decisions discussed more fully the effects of waiver denials on the public interest or public health and welfare. See e.g., 44 FR 53387 (September 13, 1979); and 44 FR 69429 (December 3, 1979).

[52] GM Reapp., p. 9.

[53] GM Reapp., p. 1, 2. February 12, 1980 Transcript, p. 188.

[54] 478 F.2d 615, 640 (D.C. Cir., 1973).

[55] For example, GM was granted a CO waiver for the 1981 model year for its 3.6L/4V turbocharged engine family in the third consolidated CO decision. 45 FR 7122, 7126 (January 31, 1980). GM also confirmed that it could use spark knock control with other, non-turbocharged engine families. February 12, 1980 Transcript, p. 255.

[56] GM Reapp., p. 9.

[57] GM provided projections of the effects on sales were it unable to market its 4.9L/4V engine family using turbocharger technology, but provided no substantiation for how it derived those figures. GM supplemental submission, February 25, 1980, p. 3.

improve the respective emissions control performance of these engine families. Specifically, Ford failed to develop and evaluate the possible advantages of using a closed-loop feedback carburetor system on its 1.3L and 1.6L/2V engine families. In addition, Ford has the opportunity to evaluate at least four other alternative CO emissions control improvements in time for model year 1982.[58] Ford should consider these options (along with any others which may be available) closely as part of its continued efforts to develop technology to enable 1982 model year vehicles of these engine families to meet the 3.4 gpm CO standard.

GM failed to do extensive monolith catalyst development on its 4.9L/V turbocharged engine family.[59] Nevertheless, in the absence of any other evidence supporting a contrary conclusion, I am unable to determine other than that both of these applicants have met the good faith criterion with respect to to the engine families under consideration in this decision.

E. *Risks in Determining Available Technology.* In *International Harvester Co.* v. *Ruckelshaus,*[60] the United States Court of Appeals for the District of Columbia Circuit reviewed the Administrator's decision to deny manufacturers' requests for a one-year suspension (from 1975 to 1976) of the effective date of the statutory hydrocarbon (HC) and CO standards mandated by the 1970 version of the Act. The Court stated, among other things, that the Administrator should have considered the risks associated with the possibility of erroneously denying the suspension requests versus the risk of erroneously granting those requests. The Court indicated that the Administrator should balance the economic costs (in terms of jobs and misallocated resources) or environmental costs possibly associated with an erroneous denial versus the possible environmental benefits lost through an erroneous grant.

Even though the health risks associated with erroneous grants for Ford's engine families in the 1982 model year and GM's engine family in both the 1981 and 1982 model years may not be great, the risks associated with erroneous denials (which do not involve health considerations) also are limited significantly. My findings that technology is available for an engine family to meet certification testing requirements are based on conservative projections.[61] The move from today's state of technology to the techology required to achieve the 3.4 gpm CO standard does not require any substantial shift to untried emission control methods. Furthermore, an incorrect determination here would have the potential to adversely affect the production of only one engine family, as opposed to the ability of the industry as a whole to produce cars for the public generally. In light of these counterbalancing risks, and in light of Congress' expressed intent to afford a statutory waiver only in exceptional circumstances rather than on an across-the-board basis,[62] I have concluded that it is appropriate to deny waiver applications insofar as they cover engine families for which the manufacturer has failed to establish that effective control technology, considering costs, driveability, and fuel economy, is not available.

IV. Conclusion

The two Ford engine families for which I determined that effective CO control technology is not available for the 1981 model year are covered by waiver applications which meet each of the remaining criteria under section 202(b)(5)(C) of the Act. As a result, I am granting a waiver of the effective date of the 1981 statutory CO emission standard for the Ford 1.3L and 1.6L/2V OHC engine families for the 1981 model year.

I have determined for GM's 4.9L/4V turbocharged engine family that effective control technology indeed is available to meet a 3.4 gpm CO standard by the 1981 model year, even after considering costs, driveability and fuel economy. For the Ford 1.3L and 1.6L/2V OHC engine families, I have determined that Ford has failed to establish that such technology, considering costs, driveability, and fuel economy, is not available for these engine families in the 1982 model year. Thus, even though these waiver applicants may meet one or more of the remaining criteria for receiving waivers, I nevertheless must deny the waiver applications covering the GM 4.9L/4V turbocharged engine family for the 1981 and 1982 model years and the Ford 1.3L and 1.6L/2V OHC engine families for the 1982 model year.

V. Interim CO Exhaust Emission Standards

As required by section 202(b)(5)(A) of the Act, I am simultaneously promulgating regulations elsewhere in this issue of the **Federal Register**, prescribing an interim CO emission standard of 7.0 gpm for 1981 model year vehicles of the two engine families receiving waivers. For these two engine families, this action continues in effect for one additional model year the CO emission standard applicable to all 1980 model year light-duty vehicles.

Dated: May 30, 1980.

Douglas M. Costle,

Administrator.

Appendix A—Summary of Technological Capability

Contents

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I. Introduction

The exhaust emission standards for 1981 and later model year light-duty vehicles are currently 0.41 gram per mile HC, 3.4 grams per mile CO, and 1.0 gram per mile NOx. Section 202(b)(5)(A) of the Clean Air Act, as amended, 42 U.S.C. 7521(b)(5)(A) provides the opportunity for manufacturers to request a waiver of the 3.4 grams per mile CO standard to 7.0 grams per mile during model years 1981 and 1982.

The applicants being considered in this document are Ford and General Motors. This is the fourth group of CO waiver applications that have been considered by EPA. This is the third time that a waiver request has been considered by EPA from General Motors.

This appendix deals with the technological capability of Ford and General Motors to meet the 1981 and 1982 CO standard of 3.4 grams per mile.

[58] App. A, section IX.

[59] February 12, 1980 Transcript, pp. 212–224. See App. A, sections V, IX.

[60] 478 F. 2d 615 (D.C. Cir. 1973). For further discussion of this case, see the discussion in my first consolidated decision. 44 FR 53376, 53386 (September 13, 1979).

[61] See section III(A)(1), supra. See also App. A, sections III, V. Although the Monte Carlo technique employed here differs slightly from that used in previous decisions, this Modified Monte Carlo produces a more accurate projection of liklihood of successful certification while still maintaining conservation variabilities where necessary. See the discussion in section III(A)(2). See also, App. A, sections III, V.

[62] See also the discussion of this issue in the following previous waiver decisions: 44 FR 53376, 53387 (September 13, 1979); 44 FR 69416, 69429 and 69430 (December 3, 1979). In my fourth consolidated decision I based my decision to grant waivers on the combined risks presented from two factors: (1) the severity of the adverse economic consequences which could occur as the result of an erroneous denial; and, (2) the likelihood that the denial, in fact, will turn out to be ill-founded. 45 FR 17914, 17917 (March 19, 1980). Neither Ford nor GM has established that these factors contradict my findings here.

This appendix relies on three previous technical appendixes, particularly for explanation of the basic concepts of the Monte Carlo simulation utilized in this analysis. These appendixes are:

1. Appendix B, Technical Appendix, to the Decision of the Administrator on Remand for the United States Court of Appeals for the District of Columbia Circuit, April 11, 1973.

2. Appendix A, Technical Appendix, to the Decision of the Administrator In re: Applications for Suspension of 1976 Motor Vehicle Exhaust Emission Standards, July 30, 1973.

3. Appendix A, Technical Appendix, to the Decision of the Administrator In re: Applications for Suspension of 1977 Motor Vehicle Exhaust Emission Standards, March 5, 1975.

As indicated in Section 202(b)(5)(c)(iii) of the Clean Air Act, the technological feasibility determination is based on the consideration of technological capability, cost, driveability, and fuel economy. This appendix contains discussion of each of the above topics.

II. Summary of Technological Capability

Tables II–1 and II–2 summarize the capability of the applicant manufacturers to meet the 1981 and 1982 emission standards. The standards considered in these tables are 0.41 HC, 3.4 CO, 1.0 NOx.

A guide to the summary tables is as follows. The first column lists engine displacement. The "as received" column refers to the emission data submitted by the manufacturer. "Improvements" refer to the projected technological improvements (factors) applied to the data submitted by the manufacturer. The "no data" category is an abbreviated notation for the lack of acceptable data to perform EPA's established technological analysis as referred to in EPA's published CO waiver guidelines. The applicants have known for about six years what sort of data is necessary for EPA to make a determination under its established methodology whether or not a given vehicle would be projected to pass or fail a set of standards. Unfortunately, in some cases there was a lack of useable data for vehicles using specific engines. This effectively precluded EPA from making a pass/fail determination for those vehicles through the established methodology. In these cases the vehicles using these engines are called "no data" and no pass/fail determination was made.

Table II–1.—Applicant: Ford

Engine	Pass as received?	Pass with improvement?
1.3L–2V	In 1981 No In 1982 No data	N/A.[1]
1.6L–2V—OHC	In 1981 No In 1982 No data	N/A.

[1] N/A means not applicable or that no hardware improvement factors were applied to these vehicles.

Table II–2.—Applicant: General Motors

Engine	Pass as received?	Pass with improvement?
4.9L–4V–TC	Yes	N/A.[1]

[1] N/A means not applicable or that no hardware improvement factors were applied to these vehicles.

III. Statistical Treatment of the Data

The standard Monte Carlo methodology has not been used for the analysis in this appendix. No changes have been made in the standard Monte Carlo methodology since its last use in a technical appendix. This methodology, which is the foundation for the Modified Monte Carlo methodology for certification vehicles has been discussed in three previous technical appendixes:

1. Appendix B, Technical Appendix, to the Decision of the Administrator on Remand for the United States Court of Appeals for the District of Columbia Circuit, April 11, 1973.

2. Appendix A, Technical Appendix, to the Decision of the Administrator In re: Applications for Suspension of 1976 Motor Vehicle Exhaust Emission Standards, July 30, 1973.

3. Appendix A, Technical Appendix, to the Decision of the Administrator In re: Applications for Suspension of 1977 Motor Vehicle Exhaust Emission Standards March 5, 1975.

A Modified Monte Carlo simulation has been developed and utilized in this appendix to handle a new situation which has arisen in this waiver proceeding. The new situation was that the Administrator had to make a decision to grant or deny waivers based on actual certification vehicles with less than complete mileage accumulation for a given model year which is also a year for which a waiver has been requested. This circumstance initially occurred in the technical appendix for the decision on Peugeot and Renault, and the circumstances have again occurred for both Ford and General Motors. Specifically, the initial circumstance was that Renault had a 1981 model year durability vehicle (vehicle 785) in EPA certification. Car 785 had accumulated over 40,000 of the mandatory 50,000 miles of durability mileage accumulations. Based on all current emission data points, the vehicle met the 1981 emission standards. Based on the least-squares-fit straight line through all current data, the vehicle was projected to pass the 1981–1982 standards. Based on the standard Monte Carlo methodology, the vehicle was projected to marginally fail CO emissions.

If the Renault vehicle had completed the 50,000 miles at the projected emission levels, the waiver would have probably been denied. And if the Renault vehicle were a prototype development vehicle instead of an actual 1981 certification vehicle, the vehicle would clearly have been considered to fail as in previous decisions.

The standard Monte Carlo is used to predict the probabilities of an untested certification vehicle passing the emission standards based on the test data from a prototype durability vehicle of identical construction. Car-to-car variability, test-to-test variability, and deterioration factor variability are applied to the prototype vehicle data. Use of the standard Monte Carlo methodology in the case of the Renault certification vehicle would be inappropriate to determine the probability of passing certification because the three variabilities would be applied to vehicle results for which there is no real life variability; i.e., the first 40,000 miles of data are actual certification data and will be used precisely as they exist to determine pass/fail in certification.

Because of the inappropriateness of the standard Monte Carlo for predicting the certification results of actual certification vehicles, a modified version of the Monte Carlo was developed such that the predictive methodology could be validly applied to certification vehicles.

In the standard Monte Carlo program, the following steps take place:

1. A d.f. value and a 50,000 mile intercept are calculated from the actual vehicle data and are input into the program.

2. The Monte Carlo program calculates the 4,000 mile intercept.

3. A random 4,000 mile point is selected form the normal distribution of car-to-car variability centered around the calculated 4,000 mile point.

4. A new d.f. line is fitted through the randomly selected 4,000 mile point. This new or second d.f. line is an increment of the actual d.f. line. This increment is randomly selected form the d.f. variability distribution.

5. From the adjusted d.f. line, which passes through the adjusted 4,000 mile

point, temporary points are then calculated at mileage increments of 5,000, 10,000, and 15,000, etc. Final values for these points are then chosen by randomly applying test-to-test variability to the temporary emission values.

6. A d.f., a 4,000 mile intercept, and a 50,000 mile intercept are calculated from the data points generated in step five.

7. The preceding steps are repeated 100 times.

In the Modified Monte Carlo for certification vehicles, the variability distributions for car-to-car, d.f. and test-to-test variabilities are not applied to actual certification test points. The variabilities are only used for the projected test points.

In the Modified Monte Carlo for certification vehicles, the following steps take place:

1. A d.f. value and a 50,000 mile intercept are calculated from the actual certification data and are input into the program.

2. The Monte Carlo program calculates the first projected test point beyond the actual test points.

3. A random value is selected for the first projected data point. For instance, if certification test data includes the 40,000 mile test point, the first projected point would be the 45,000 mile point. The value for the first projected point is randomly selected by applying car-to-car variability to the calculated test point. Since, in reality, car-to-car variability should not exist because there is no change in vehicles, this portion of the calculation adds conservatism to the analysis.

4. A new d.f. line is fitted through the randomly selected value for the first projected point. This new or second d.f. line is calculated by adding or subtracting a d.f. increment to the original d.f. line. This increment is also picked at random, from the d.f. variability distribution.

5. From the adjusted d.f. line, which passes through the adjusted value for the first projected data point, points are picked at 5,000 mile increments of up to 50,000 miles. Values are also projected for before and after scheduled maintenance test points. The values for these data points are randomly selected from the test-to-test variability distribution.

6. A d.f., a 4,000 mile intercept, and a 50,000 mile intercept are calculated from all the data points, both actual and projected.

7. The preceding steps are repeated *1000* times.

In the Modified Monte Carlo for certification vehicles, it should be apparent, from the preceding explanation, that the variability distributions for car-to-car, d.f. and test-to-test variabilities are only used in conjunction with the projected data points, and not with actual certification test points. The values of the variabilities are identical to those used in the standard Monte Carlo. Also the modified Monte Carlo is used only to analyze incomplete 1981 model year certification vehicles.

IV. Factors

With respect to the vehicle emission data submitted by the manufacturers for EPA analysis, vehicles are often run and tested over durability mileage accumulation schedules without using the best technology that is available to the manufacturer for certification in the 1981 or 1982 model years. There are many reasons why this occurs. First, such technology may have simply not been available in quantity when fleets of vehicles began mileage accumulation. Second, all vehicles submitted for EPA staff analysis may not have been specifically designed for the 1981 and 1982 Federal emission standards. Also, the manufacturer may wish to maintain some technologies (with known durability) in reserve if their low mileage testing indicates that such technology may not be needed for compliance with the target emission standards. In addition, technology may not appear on durability vehicles because the manufacturer has made a decision that the technology would be too costly for production vehicles.

Factors which have previously been developed, but generally not used in the following analysis include factors for:

- Warm up catalysts for 3W catalyst or 3W+OC systems
- Deletion of power enrichment
- Use of insulated or dual-walled exhaust pipes
- Use of exhaust port liners
- Use of throttle body fuel injection
- Use of multiple point fuel injection

Although the deletion of power enrichment was considered feasible for 1981, factors for this improvement were not used. Therefore, through these additional techniques, the manufacturers may have some additional cushion for certification over and above the factors used in EPA's analysis. Use of the other items was not considered possible for most manufacturers for most engine families before the 1982 model year.

No factors were used for emission control system improvements for vehicles in this analysis. The GM vehicles passed without factors so no additional emission control hardware was necessary for compliance with the emission standards. Development data was not provided by Ford and therefore no data was available for developing hardware improvement factors for 1982.

V. Discussion of Individual Manufacturers' Technical Capability

This section will discuss all vehicles which (1) were submitted by each of the two applicants and (2) also are acceptable for input into the Monte Carlo simulation. Acceptable for input means (1) that the vehicle is a durability vehicle which has accumulated a minimum of 20,000 miles with the same major emission control components and (2) that a minimum of four valid 1975 FTP tests have been conducted on the vehicle.

Details of the pass/fail determinations in section II are also presented here. To pass the 1981 and 1982 emission standard (of 0.41 HC, 3.4 CO, 1.0 NOx), the probabilities of passing each individual pollutant must be greater than or equal to 80% in the Modified Monte Carlo for certification vehicles. If the probability of passing only HC, for example, is less than or equal to 79%, the vehicle fails—even if the probabilities for CO and NOx greatly exceed the 80% cutpoint.

Ford Motor Company (Ford)

this is the first group of waiver applications received from Ford. In their current application, Ford has requested waivers to 7.0 CO for vehicles using their new 1.3 and 1.6 liter engines. The engines are currently considered by EPA to be in different engine families.

No prototype durability vehicles were tested by Ford; however, a substantial number of 1981 certification vehicles have been or are now being run by Ford.

All of the vehicles discussed in the Ford waiver application and subsequent waiver information provided by Ford are shown in table V–1. A few vehicles have been added by the EPA technical staff to complete the Ford certification outlook. Virtually all vehicles are 50-State certification vehicles.

Table V-1.—*Vehicles in Ford Waiver Application*

Engine	VIN	Emission control system	Entered in Monte Carlo?	If not entered in Monte Carlo—why?	Comment	Reference
1.3	001	BPEGR/AIR/OC	No	Insufficient mileage accumulation	1981 50-States certification vehicle—now cancelled.	2 at section IIIB and 3 at attachment IV.
1.3	002	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—complete, but data may not be accepted by EPA.	2 at section IIIB and 3 at attachment IV–V and 5 at attachment I.
1.3	003	Unknown	No	Insufficient mileage accumulation	1981 certification vehicle—disqualified due to head porosity.	EPA certification records.
1.3	004	BPEGR/AIR/3W [1]	Yes		1981 50-States certification vehicle—now cancelled.	2 at section IIIB and 3 at attachment IV.
1.6	[2]005	BPEGR/AIR/3W [1]	Yes		1981 50-States certification vehicle—active, 40k.	4 at attachment III, p 7–8.
1.6	006	SONIC EGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—now cancelled.	2 at section IIIB and 3 at attachment IV.
1.6	007	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—now cancelled.	2 at section IIIB and 3 at attachment IV.
1.6	008	SONIC EGR/AIR/3W/OC	No	Insufficient mileage accumulation	1981 certification vehicle—now cancelled.	EPA certification records.
1.6, 17–18	[2]190	BPEGR/AIR/3W/3W [1]	No	Insufficient mileage accumulation	1981 50-States certification vehicle—15K.	4 at attachment III, p.
1.6, 19–20	165	BPEGR/AIR/3W/OC	No	Insufficient mileage accumulation	1981 50-States certification vehicle—10K.	4 at attachment III, p.
1.6	070		No	Insufficient mileage accumulation	1981 50-States certification vehicle—5K.	EPA certification records.
1.6	164		No	Insufficient mileage accumulation	1981 certification vehicle—on hold	EPA certification records.
1.6	166	BPEGR/AIR/3W/3W [1]	No	Insufficient mileage accumulation	1981 50-States certification vehicle—10K.	EPA certification records.
1.6	167		No	Insufficient mileage accumulation	1981 certification vehicle—no mileage	EPA certification records.
1.3	337		No	Insufficient mileage accumulation	1981 certification vehicle	3 at attachment III.
1.3	100	BPEGR/AIR/3W/OC	No	Insufficient mileage accumulation	1981 50-States certification vehicle—OK.	3 at attachment III.
1.6	057	BPEGR/AIR/3W/OC	Yes		1981 50-States Certification vehicle—now cancelled.	2 at section IIIB, 3 at attachment IV.
1.6	000		No	Insufficient mileage accumulation	Development vehicle	3 at attachment VIII.
1.3	050	BPEGR/AIR/3W/3W [1]	No	Insufficient mileage accumulation	1981 50-States certification vehicle—now cancelled.	EPA certification records.
1.3	072	BPEGR/AIR/3W/OC	No	Insufficient mileage accumulation	1981 50-States certification vehicle—now cancelled.	4 at attachment III, p 1–2.
1.3	182	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—now cancelled.	4 at attachment III, p 3–4.
1.3	[2]329	BPEGR/AIR/3W/3W [1]	Yes		1981 50-States certification vehicle—20K.	4 at attachment III, p 5–6.
1.6	071	BPEGR/AIR/3W/OC	No	Insufficient mileage accumulation	1981 50-States certification vehicle—10K.	4 at attachment III, p 9–10.
1.6	075	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—30K.	4 at attachment III, p 11–12.
1.6	160	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—20K.	4 at attachment III, p 13–14.
1.6	161	BPEGR/AIR/3W/OC	Yes		1981 50-States certification vehicle—25K.	4 at attachment III, p 15–16.

[1] Apparently used as an oxidation catalyst.
[2] Reportedly cancelled after preparation of this table.

Pass/Fail Analysis of Ford Vehicles Using the 1.3 Liter 2V Engine

A total of four 1981 model year certification durability vehicles were included in the pass/fail analysis of this family. All vehicles except vehicle 002 were analyzed using the Modified Monte Carlo for certification vehicles which is discussed in section III of this document.

Since car 002 has completed durability mileage accumulation, no simulation of its certification capability is necessary. The car has completed durability testing at emission levels below the 0.41 HC, 3.4 CO, 1.0 NOx standard. The emission results from vehicle 002 and the remaining vehicles with 1.3 liter engines aer shown in table V–3.

Two of the four vehicles, cars 004 and 182, have been cancelled. One of the vehicles, car 329, is still accumulating mileage. Probabilities of passing were generated for these cars as shown in table V–2. Car 182 is projected to fail HC, CO, and NOx emissions, and car 329 is projected to fail HC and NOx emissions, and car 004 is projected to fail HC, CO and NOx emissions.

Although car 002 completed 50,000 miles of durability mileage accumulation at emission levels below the statutory HC, CO and NOx standards, Ford performed unscheduled maintenance and parts replacement on this vehicle to remedy fairly severe emission problems. As a result, car 002 does not represent a total engine/emission control system that has demonstrated compliance with emission standards for 50,000 miles, nor does it represent the vehicles that Ford plans to produce for sale in 1981. In addition to the question of whether the durability data from car 002 should be accepted for certification purposes, this raises the question of whether EPA should treat this vehicle as a certification vehicle for purposes of demonstrating compliance with the statutory CO standard, i.e., as the basis for waiver denial.

The durability data-certification issue currently is under consideration within the Agency. While it has not been decided whether durability data from car 002 will be accepted for certification, conditional or otherwise, the same factors to be considered in that decision provide the basis for rejecting car 002 as having demonstrated compliance with the statutory standards. This vehicle may not have met emission standards without unscheduled maintenance, so that vehicles in-use could very well exceed the standards even if a waiver is denied. Since vehicle 002 is being rejected as a data vehicle for purposes of this waiver decision the 1.3 liter

engine families are projected to fail in 1981 model year certification. Technological options for model year 1982 were not evaluated using the Monte Carlo as little information was provided by Ford on their capabilities for 1982.

TABLE V-2.—*Modified Monte Carlo Results of Ford Certification Durability Vehicles Using 1.3 Liter Engines*

VIN	IW	Certification engine family	3W catalyst code[2]	OC catalyst code[2]	Probability of pass			Comment
					HC	CO	NO_x	
002	2250	1.3AF	TR	XR	Not run—complete			EPA may not accept this vehicle data.
004	2250	1.3AB	TR	None	0	2	71	Cancelled.
182	2250	1.3AG	TR	XR	68	41	0	Cancelled.
329	2250	1.3AA	TT	TT	57	100	0	Cancelled recently.

Table V-3.—*Emission Results of 1981 For Certification Vehicles Using 1.3 Liter-2V Engines*

Miles	HC	CO	NO_x
VIN: [1]004			
4,829	0.22	1.91	0.62
9,840	.19	1.81	.64
14,811	.35	2.75	.73
19,906	.30	1.86	.62
24,954	.35	1.92	.75
29,880	.41	2.35	.87
29,952	.45	2.56	.93
34,816	.45	3.66	[illegible]
39,826	.50	4.61	.80
Proj 4k[3]	.19	1.44	.61
Proj 50k[3]	.59	4.23	[illegible]
df[3]	3.03	2.95	1.55
VIN: 002			
4,813	0.31	2.23	0.49
9,809	.37	2.58	[illegible]
14,806	.31	2.40	.54
19,806	.29	2.21	.90
25,159	.35	2.53	.82
29,821	.30	3.07	.64
29,840	.26	1.82	.65
34,826	.37	2.72	[illegible]
39,814	.30	3.18	.70
44,763	.28	3.33	.65
49,764	.23	2.67	.59
Proj 4k	.34	2.20	.65
Proj 50k	.27	3.00	[illegible]
df	.80	1.36	1.06
VIN: [1]182			
4,807	0.26	1.62	0.96
9,810	.33	1.64	.93
14,764	.42	2.36	1.16
19,810	.26	2.16	2.78
Proj 4k[3]	.30	1.56	.51
Proj 50k[3]	[illegible]	3.71	5.76
df[3]	1.27	2.38	11.27

Table V-3.—*Emission Results of 1981 For Certification Vehicles Using 1.3 Liter-2V Engines*—Continued

Miles	HC	CO	NO_x
VIN: [3]329			
4,814	0.21	1.84	0.61
9,828	.20	1.84	.68
14,798	.32	1.91	.78
19,808	.24	1.50	.89
Proj 4k[3]	.21	1.93	.58
Proj 50k[3]	.40	1.06	1.45
df[3]	1.93	.55	2.48

[1] Cancelled vehicle.
[2] Recently cancelled.
[3] Based on less than complete 50,000 mile durability.

Pass/Fail Analysis of Vehicles Using 1.6 Liter Overhead Camshaft Engines and 2V Carburetors

A total of seven 1981, model year certification durability vehicles using 1.6 liter engines were analyzed by the EPA technical staff. All vehicles were evaluated using the Modified Monte Carlo for certification vehicles. The projected Monte Carlo results are shown in table V–4. The seven vehicles are projected to badly fail the standards of 0.41 HC, 3.4 CO, 1.0 NOx. All vehicles except one (161) are projected to fail two or three pollutants.

Neglecting the Monte Carlo analysis and projected emissions temporarily and looking only in comparison to the emission standards at actual emission tests, the only vehicle which has accumulated 20,000 miles or more and is still active without exceeding one or more emission standards is vehicle 161. From those seven vehicles for which EPA calculated deterioration factors, this appears to be the only car with even a small chance of meeting the 0.41 HC, 3.4 CO, 1.0 NOx emission standard. The actual certification results of this and the other six durability vehicles are also shown in table V–5. CO emissions appear to be also deteriorating so rapidly on car 161 that it probably will not pass the 3.4 standard and even with a 7.0 CO waiver, car 161 appears to be the only car which may pass.[1]

	HC	CO	NOx
Proj. 4K	.179	2.39	.88
Proj. 50K	.286	4.33	1.01
df	1.60	1.81	1.15

There is no questionable maintenance reported on this vehicle, and the vehicle could probably be certified to a 0.41 HC, 7.0 CO, 1.0 NOx standard

[1] Car 075 was very recently reported to have completed the 50,000 mile durability process with the following emission results:

Table V-4.—*Modified Monte Carlo Results of Ford Certification Durability Vehicles Using 1.6 Liter Engines*

VIN	IW code[2]	Certification engine family[1]	3 W catalyst	OC catalyst codes[2]	Probability of pass			Comment
					HC	CO	NO_x	
005	2500	1.6AJ	TT	None	1	31	100	Complete, but now cancelled.
006	2500	1.6AB	TR	XR	1	0	0	Cancelled.
007	2500	1.6AH	TR	XR	0	5	0	Cancelled.
057	2500	1.6AC	TT	XR	0	98	0	Cancelled.
075	2500	1.6AG	TR	X	64	0	50	
161	2500	1.6AE	TT	XR	98	14	100	
160	2500	1.6AF	TT	X	[illegible]	0	100	

[1] Note that all vehicles are in different certification engine families.
[2] Identical catalyst codes do not always indicate catalysts. Different catalyst codes do indicate catalysts.

Table V–5.—*Emission Results of Ford Certification Vehicles Using 1.6 Liter-2V Engines*

Miles	HC	CO	NO_x
VIN: [illegible]057			
4,861	0.15	2.82	0.75
9,845	.19	2.38	.93
14,808	.33	2.76	.94
19,804	.36	2.66	1.25
24,807	.42	2.35	1.48
Proj 4K [2]	.14	2.74	.68
Proj 50 [2]	.79	2.13	2.33
df [2]	5.82	.78	3.40
VIN: [illegible]007			
4,806	0.24	2.42	0.83
9,844	.36	4.39	.83
14,779	.52	4.36	1.11
19,807	.50	2.87	1.29
Proj 4K [2]	.25	3.29	.74
Proj 50K [2]	1.11	4.51	2.27
df [2]	4.48	1.37	3.07
VIN: [illegible]006			
4,828	0.16	0.54	0.73
9,826	.13	2.60	.75
14,847	.26	3.95	1.56
20,011	.29	3.09	1.92
Proj 4K [2]	.13	1.06	.51
Proj 50K [2]	.62	9.20	4.50
df [2]	4.91	8.66	8.76
VIN: [illegible]005			
4,857	0.24	1.29	0.61
9,807	.32	1.52	.68
14,833	.34	1.72	.56
19,826	.38	2.98	.47
24,816	.31	1.62	.63
29,804	.33	2.62	.63
29,832	.45	3.03	.55
34,821	.54	2.96	.51
40,134	.37	2.91	.47
Proj 4K [2]	.27	1.34	.63
Proj 50K [2]	.50	3.63	.48
df [2]	1.83	2.72	.75
VIN: [illegible]078			
4,812	0.15	2.08	0.87
9,822	.17	2.59	.85
14,808	.22	3.07	.97
19,808	.21	3.00	.93
24,813	.22	2.67	1.04
29,807	.26	4.49	.92
29,836	.31	3.93	.96
Proj 4K [2]	.14	2.04	.87
Proj 50K [2]	.39	5.34	1.06
df [2]	2.74	2.60	1.21
VIN: [illegible]161			
4,817	0.12	1.01	0.79
9,789	.16	1.90	.65
14,819	.15	1.88	.80
19,829	.17	2.22	.64
24,815	.19	2.61	.63
Proj 4K [2]	.13	1.16	.77
Proj 50K [2]	.26	4.40	.47
df [2]	2.10	3.78	.61
VIN: [illegible]160			
4,830	0.24	1.81	0.86
9,826	.18	2.45	.74
14,811	.16	2.33	.75
19,807	.23	3.72	.56
24,805	.35	3.37	.75
Proj 4K [2]	.17	1.78	.82
Proj 50K [2]	.42	5.83	.45
df	2.43	3.27	.55

[1] Vehicle was cancelled.
[2] Based on less than complete durability.

Failure Analysis of Ford Certification Vehicles

As background information, the 1.6 liter engine for which a waiver has been requested is at best a distant derivation of the 1.6 liter Fiesta engine. The engine has been modified substantially from the 1.6 Fiesta engine in that the combustion chamber is totally new and the cam/valve arrangement has been changed from simply an overhead valve to an overhead camshaft arrangement. Thus, the cylinder head and engine block are new. We assume the pistons are new and that only the remaining lower end of the engine may be similar to the Fiesta engine. [2 at 7 to 8].

The new 1.6 liter engine has a cross flow head. This air flow pattern is normally chosen because it provides increased power output compared to an engine with the intake and exhaust manifolds on the same side of the engine. Inherent disadvantages in the cross flow head design are the need for longer EGR passages and difficulty in adapting an exhaust heated early fuel evaporation (EFE) system. Ford has not attempted to use exhaust heated EFE on these models. The 1.3 liter engine is much like the new 1.6 liter engine in design.

Table V–6 lists the Ford vehicles which have currently been dropped from the certification process. Six vehicles have been victims of catalyst failures. Half of the vehicles used 1.3 liter engines, and half used the 1.6 liter engines. Two vehicles are shown to have EGR system problems, but the problem is even more severe than shown here because some of the active vehicles have had repairs for EGR system plugging. The EGR problem has also occurred on vehicles with both the 1.3 liter and 1.6 liter engines.

Table V–6.—*Ford Vehicles That Have Been Dropped From 1981 Certification*

Ford explanation of failure	VIN	ENG	WAVE
Breakage of catalyst substrate due to overtemperature from choke malfunctions.	058	1.3	I
Catalyst deterioration due to CO spikes and excess oxygen.	057	1.6	I
Power loss and stalling	[illegible]	1.6	II
Catalyst deterioration due to excessive WOT enrichment with excess oxygen or plug wire off.	[illegible]	1.3	II
High oil consumption due to head porosity.	[illegible]	1.3	II
Catalyst deterioration due to CO spikes excess oxygen.	[illegible]	1.6	II
Catalyst melt due to CO spikes and excess oxygen.	007	1.6	II
Catalyst melt due to mixup of fuel and vent lines or choke problems.	001	1.3	III
Plugged EGR backpressure sensor tube.	182	1.3	IV
Plugged EGR backpressure sensor tube.	072	1.3	IV

Ford seems to have chosen a relatively inexpensive emission control system for use on the Escort/Lynx vehicles, compared to the systems they certified on other vehicles. Examples of areas where Ford has attempted to reduce cost on the 1.3/1.6L engines are:

(1) All of the vehicles Ford has attempted to certify use open loop carburetors and no oxygen sensors.

(2) None of the vehicles Ford has attempted to certify use an electronic or microprocessor control unit. Ford has used these for control of air/fuel ratio, spark advance, and exhaust gas recirculation on other models.

(3) Only two of the vehicles Ford has attempted to certify have used the more expensive sonic EGR system as opposed to the back pressure EGR system.

(4) Catalyst volumes have generally been reduced from the 152 and 128 cubic volumes certified on the Fiesta in 1980 (for compliance with the less stringent 1980 emission standards).

The design and cost decisions made by Ford may have had an impact on Ford's ability to certify these models. The Escort/Lynx are expected to be the most inexpensive vehicles offered by Ford. Pricing competition for low cost models appears to be the motivation for many of the Ford decisions. As explained by Ford at the altitude hearings, lower first cost is the reason Ford is attempting to certify many of their vehicles using open loop emission control systems [11 at 173 to 186].

The most serious emission related problems which have been encountered by Ford in their certification efforts have been loss of catalyst efficiency and plugging of EGR systems.

Ford initially thought the EGR system problems would be solved by a change in intake manifold design. After plugging was encountered with the new manifold design, Ford now believes that the problem is due to insufficient exhaust gas temperatures in the EGR system. Ford has proposed to remedy the situation by using an "appropriate insulated sock" and other modest system modifications. The latest fix has not yet been installed on a durability vehicle. Another solution, although necessarily a longer term one, could be to design a passage through the cylinder head to reduce the passage length.

The catalyst deterioration problem may not be as close to resolution. Ford stated that they believe the major problem is the result of both CO spiking and excess oxygen provided by the AIR system [1 at 123 to 132]. Ford has stated that they are able to maintain stoichiometry about 80 percent of the time and the addition of feedback control would not provide a substantial emission control benefit [1 at 130 to 131] [3 at 3]. Attachment VII of reference 3 provides their support for these statements. This attachment, which is a plot of air/fuel ratio versus time over portions of the FTP, does not support the Ford statements. Stoichiometry is

maintained only rarely with considerable time spent in the rich and lean regimes. The system went to rich or richer than 3.7 air/fuel ratio on about ten occasions over the portion of the test shown by Ford. Some of the rich excursions are fairly long in duration and EPA believes that these rich excursions may be the source of the high catalyst temperatures experienced by certification vehicles. If this is the case, the use of a feedback control system could provide a substantial improvement in emission control.

Based on current literature [19], an optimal air/fuel metering system for maximum 3-way catalyst efficiency utilizes air/fuel ratio modulation of higher frequency and low amplitude. The open loop carburetion selected by Ford is as close to the opposite of optimal for 3-way control as will be used by any vehicle manufacturer in 1981. The amplitude of modulation is high and the frequency is low.

The solutions being pursued by Ford to solve the catalyst over-temperature problems are:

- Reduced normal air injection flow rates
- Dumping of air injection on wide open throttle accelerations
- Dumping of air at idle
- Use of throttle dashpots
- An improved choke
- Carburetor recalibration
- Underfloor 3-way plus oxidation catalyst systems
- Revised WOT spark [3 at attachment III]

Several variations of catalyst locations (flangemount versus underfloor), catalyst types (3W only, 3W plus OC, OC only), and catalyst formulations (varying noble metal ratios and loadings) have been utilized by Ford in their certification efforts. The most important variations in terms of catalyst overtemperature are location and type. Ford seems to have eliminated 3-way only catalyst systems and oxidation catalyst only systems from consideration for 1981. This leaves the 3-way plus oxidation catalyst system as the only remaining alternative. Also the flangemounted catalyst location has been dropped to help resolve the overheating problem.

Most of the catalyst overtemperature problems have been with the system which include at least one flangemounted catalyst. One overtemperature problem (car 007) has occurred with a vehicle having all catalysts located under the floor.

It is the judgment of the EPA technical staff that a 7.0 CO standard for vehicles using the 1.3 and 1.6 liter engines can provide an additional margin of safety to protect against catalyst overtemperature problems if Ford utilizes the additional CO margin for reduction of injected secondary air. If sufficient catalyst overheating occurred, it is likely that overall Lynx/Erika emissions could be higher without a waiver than with a waiver. If this extra margin is utilized for other purposes, such as increased enrichment for improved driveability, catalyst overtemperature problems could remain.

The open loop oxidation catalyst system with sonic EGR may also offer considerable promise if Ford has achieved a reasonably fast burn rate in this engine. This type of system has been tried by Ford in the 1981 model year program without sonic EGR.

The Newest Ford Certification Vehicles

The emission control system descriptions for the latest Ford certification durability vehicles are not totally complete; however, most appear to use underfloor 3-way plus oxidation catalyst systems, back pressure EGR, and reduced AIR strategies. Open loop carburetion has also been retained. At least one of the vehicles (071) was reported to have a substantially reduced 3-way catalyst loading compared to prior vehicles.

As shown in the V–7 only car 168 shows potential for meeting 3.4 CO. We suspect that this vehicle also has a reduced catalyst loading and will deteriorate rapidly in CO.

Table V–7.—*Active Ford Certification Vehicles That Were Not Included in the Monte Carlo Analysis*

[Last Emission Test]

VIN	ENG	[illegible] (1000)	HC	CO	NO_x
070	1.6	5	.28	[illegible]05	.66
071	1.6	10	.24	[illegible]29	.56
165	1.6	10	.23	4.70	.43
166	1.6	10	.19	[illegible]90	.62
168	1.3	[illegible]	.21	1.21	.54
164	1.6	(1)			

[1] On hold, wrong build.

General Motors (GM)

This is the third CO waiver application that EPA has considered from General Motors. The prior waiver applications were:

(1) for all 1981 and 1982 model year vehicles; and

(2) for vehicles using 3.8 L/231 CID turbocharged engines with four barrel, feedback carburetors.

The current application is for vehicles powered by the 4.9 L/301 CID turbocharged engine using a four barrel, feedback carburetor.

Data were not reported by GM from any development durability vehicles; however, data were reported for a total of five 1981 50—State certification durability vehicles and numerous development vehicles at low mileage. All the certification vehicles were equipped with about the same emission control system except for the catalysts. The system included feedback carburetion (FBC), backpressure exhaust gas recirculation (BPEGR), switched air injection (AIR), electronic spark advance (ESA), electronic idle speed control (EIS), and pelleted 3-way plus oxidizing catalysts (3W/OC). Variations in catalyst parameters were the most distinguishable engine family determinators.

A complete list of the vehicles presented by GM in their waiver application is shown in the table V–8. All five certification vehicles were considered in the pass/fail analysis, and four vehicles were entered into the Modified Monte Carlo analysis. These include vehicles 1261, 1262, 1263, and 1264. Vehicle 1260 is a completed 1981 certification vehicle. Since it is complete, a computer simulation of its capability to certify is not needed. One additional vehicle (1245) was also entered into the analysis by the EPA technical staff to illustrate a technological option open to GM. Car 1245 is powered by a naturally aspirated version of the 4.9L engine. This latter engine is not the subject of the GM waiver request.

Emission results which have been obtained from the six 1981 model year durability vehicles are presented in the table V–9 and table V–10. These results include all GM tests provided to EPA prior to about April 4, 1980. It should be noted that vehicles 1260 and 1245 have both completed the 50,000 mile durability test and have passed the 1981 emission standard of 0.41 HC, 3.4 CO, 1.0 NOx. Since these are completed 1981 model year durability vehicles from certification, there is no need for a Monte Carlo simulation to determine the probability of success of an identical vehicle in certification. A simple pass/fail determination can be made from the current data. Both vehicles 1260 and 1245 pass.

From table V–11 is clear that the emission control system on vehicle 1264 has demonstrated excellent emission control through the 30,000 miles which have been accumulated on the vehicle. There appear to be two identifiable reasons for the improved emissions of this car. First, it has a more heavily loaded catalyst than any of the other cars, and second, the integral and proportional gain rates used for

feedback control of the air/fuel ratio are substantially different than used on the other vehicles. The gain rate changes alone were reported by GM to result in substantial CO emission reductions [7 at 8].

Table B–8.—*Vehicles in GM Waiver Application*

Engine	VIN	Emission control system	Entered in Monte Carlo?	If not entered in Monte Carlo—why?	Comment	Reference
4.9L–TC–4C	9782	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 to 16 and 6 at A–27 and 7 at 5 to 6.
4.9L–TC–4V	1260	FBC/BPEGR/AIR/ESA/EIS/3W/OC.	No	Vehicle is complete	1981 50-State certification vehicle	6 at A–5 to A–7.
4.9L–TC–4V	1261	FBC/BPEGR/AIR/ESA/EIS/3W/OC.	Yes		1981 50-State certification vehicle	6 at A–9 to A–11.
4.9L–TC–4V	1262	FBC/BPEGR/AIR/ESA/EIS/3W/OC.	Yes		1981 50-State certification vehicle	6 at A–13 to A–15.
4.9L–TC–4V	1263	FBC/BPEGR/AIR/ESA/EIS/3W/OC.	Yes		1981 50-State certification vehicle, cancelled.	6 at A–17 to A–19.
4.9L–TC–4V	1264	FBC/BPEGR/AIR/ESA/EIS/3W/OC.	Yes		1981 50-State certification vehicle	6 at A–21 to A–23.
4.9L–TC–4V	8722	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 to 16 and 6 at A–25.
4.9L–TC–4V	97135	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 and 6 at A–26 and 7 at 9 and 7 at 12.
4.9L–NA–4V[1]	9787	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 and 7 at A–28.
4.9L–NA–4V[1]	97141	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 and 6 at A–29.
4.9L–NA–4V[1]	97120	FBC/BPEGR/AIR/ESA/3W/OC.	No	Insufficient mileage accumulation	Development vehicle	6 at 15 and 6 at A–30.
4.9L–TC	27R03		No	Insufficient mileage accumulation	Development vehicle	7 at 2.
4.9L–TC	273		No	Insufficient mileage accumulation	Development vehicle	7 at 2.
4.9L–TC	9732	3W/OC	No	Insufficient mileage accumulation	Development vehicle	7 at 5.
4.9L–TC	97134		No	Insufficient mileage accumulation	Development vehicle	7 at 8 and 7 at 12.
4.9L–TC	97119		No	Insufficient mileage accumulation	Development vehicle	7 at 2 and 7 at 12.
4.9L–TC	97109		No	Insufficient mileage accumulation	Development vehicle	8 at 2.
4.9L–TC	97153		No	Insufficient mileage accumulation	Development vehicle	8 at 2.
4.9L–TC	8760		No	Insufficient mileage accumulation	Development vehicle	8 at 3.
4.9L–TC	8770		No	Insufficient mileage accumulation	Development vehicle	8 at 3.
4.9L–TC	1880		No	Insufficient mileage accumulation	Development vehicle	8 at 3.

[1] NA means naturally aspirated as opposed to turbocharged, the waiver application is for the turbocharged engine.

Table V–9.—*The Status of 1981 Certification Vehicles Using 4.9 Liter Turbocharged Engines*

[As of Apr. 4, 1980]

Miles	HC	CO	NO_x
Engine family: 12S4ABD—VIN: 1260			
5,067	0.286	2.47	0.78
10,043	.303	2.47	.82
15,205	.324	3.05	.87
19,790	.284	2.68	90
25,127	.326	4.31	1.00
29,778	.324	2.05	.82
29,814	.336	2.65	.88
34,898	.345	2.62	.93
40,038	.317	2.73	.95
44,787	.344	3.24	.89
49,823	.359	3.20	.88
calc 4k	.291	2.63	.83
calc 50K	.353	3.07	.93
df	1.21	1.17	1.12
Engine family: 12S4ACD—VIN: 1261			
4,792	0.274	3.64	0.79
10,067	.295	3.61	.85
15,146	.266	2.48	.79
20,084	.324	4.04	.98
25,103	.367	5.59	.94
30,070	.400	5.00	.89
30,118	.353	4.32	.88
34,852	.371	6.13	.94
calc 4K[1]	.26	2.90	.81
calc 50K[1]	.45	6.76	1.01
df[1]	1.71	2.33	1.25

Table V–9.—*The Status of 1981 Certification Vehicles Using 4.9 Liter Turbocharged Engines*—Continued

[As of Apr. 4, 1980]

Miles	HC	CO	NO_x
Engine family: 12S4ADD—VIN: 1262			
5,076.0	0.245	2.02	0.73
9,840.0	.352	2.86	.79
14,896.0	.255	2.19	.72
20,184.0	.284	3.88	.76
24,973.0	.237	1.61	.80
29,775.0	.294	2.87	.82
29,806.0	.305	2.97	.76
34,859.0	405	2.98	.74
39,776.0	.318	3.22	.83
45,005.0	.440	4.58	.88
calc 4K[1]	.24	2.07	.73
calc 50K[1]	.39	3.89	.85
df[1]	1.66	1.88	1.17
Engine family: 12S4AED—VIN: 1263			
5,143	0.315	3.87	0.69
10,121	.302	3.74	.67
14,887	.373	4.22	.82
19,860	.360	4.29	.65
25,122	.371	4.20	.68
Vehicle cancelled			
calc 4K[1]	.31	3.80	.71
calc 50K[1]	.46	4.91	.67
df[1]	1.48	1.29	.94
Engine family: 12S4ARD—VIN: 1264			
5,007	0.277	2.00	0.55
10,117	.269	1.17	.55
15,065	.273	1.71	.58

Table V–9.—*The Status of 1981 Certification Vehicles Using 4.9 Liter Turbocharged Engines*—Continued

[As of Apr. 4, 1980]

Miles	HC	CO	NO_x
Engine family: 12S4ARD—VIN: 1264			
20,069	.283	1.65	.58
24,820	.285	2.25	.57
30,068	.299	1.62	.56
30,104	.313	1.49	.60
Continuing			
calc 4K[1]	.27	1.69	.55
calc 50K[1]	.32	1 72	.61
df[1]	1.20	1.02	1.10

[1] Based on less than complete durability.

Table V–10.—*1981 Certification Results of Vehicles 1245 Using the 4.9 Liter Naturally Aspirated Engine*

[Engine Family [12S4AD]

Miles	HC	CO	NOx
5115	0.190	2.08	0.70
10046	0.241	2.41	0.66
14906	0.202	1.90	0.66
20141	0.208	2.54	0.76
24878	0.230	2.22	0.74
29775	0.246	2.57	0.78
29812	0.294	2.76	0.79
35144	0.263	3.16	0.71
39969	0.249	2.66	0.75
45122	0.241	2.57	0.74
49780	0.291	3.46	0.83
calc 4k	0.202	2.01	0.68
calc 50k	0.278	3.11	0.80
df	1.38	1.55	01.17

Table V-11.—*Monte Carlo Results of GM Durability Vehicles Using 4.9L-TC-4V Engines*

VIN	IW	Certification engine family[1]	[illegible] catalyst code[2]	[illegible] catalyst code[2]	Probability of pass			Comment
					HC	CO	NO_x	
1260	[illegible]	1254ABD	3047(P)	2934(P)	Not run			Has completed full 50K dura.
1261	[illegible]	1254ADC	3522(P)	4079(P)	[illegible]	0	[illegible]	Has completed 35K test.
1262	4000	1254ADD	3543(P)	4079(P)	79	3	100	Has completed 45K test.
1263	[illegible]	1254AED	3522(P)	4060(P)	27	0	100	Has completed 25K test, cancelled at 28,655 miles.
1264	[illegible]	1254ARD	3293(P)	2576(P)	94	100	100	Has completed 30K ASM test. Vehicle incorporation improved catalyst and revised integral and proportional control rates in ECU [7 at 6].

[1] Note that all vehicles represent different engine families.
[2] The catalyst code is a GM code number. It is always prefixed with the letters HN. The suffixes (P) or (M) mean pelleted or monolithic catalysts.

Since the gain rate modifications and higher catalyst loading were present on car 1264, and since car 1264 is projected to easily achieve the 0.41 HC, 3.4 CO, 1.0NOx standard, there was no need to apply emission improvement factors to additional vehicles.

Vehicle 1263 was cancalled by GM at 28,655 miles, apparently due to high CO emissions. HC emissions had not exceeded the standard, but were also high. This vehicle had a comparatively low catalyst loading.

Vehicles using the 4.9 liter turbocharged engine are capable of passing the 1981 emission standard, based on car 1260 which has completed 50,000 mile certification testing below the required emission levels and based on car 1264, which is projected to pass the emission standards at emission levels substantially below those achieved by car 1260.

Should any of the different 4.9 liter turobcharged engine families encounter future troubles in certification, GM has stated that they have the alternative of using the naturally aspirated, 4.9 liter engine in place of the turbocharged engine in 1981 and 1982 [1 at 205–206 and 7 at 4].

VI. Cost Analysis

EPA Cost Estimates

The costing methodology used here is essentially the same as that used in the five previous CO waiver decisions [13], [14 at 53400], [15 at 69450], [16 at 7133], [17 at 17915]. Responses to the EPA subpoena of August 8, 1979 enabled EPA to revise cost estimates and certain emission control devices, notably monolithic three-way and oxidation catalysts. The subpeona requested prices that suppliers charge the automobile manufacturers for emission control devices or systems.

Described below are EPA estimates of cost to the consumer of compliance with 3.4 vs. 7.0 CO (due to lead time problems for certain emission control devices, separate estimates are often necessary for 1981 and 1982). The changes in cost were calculated by individual engine size. These changes are based on the differences in emission control hardware between (a) systems targeted to meet 7.0 CO, as described by each manufacturer in their applications and (b) systems judged capably by EPA of meeting 3.4 CO, based on Monte Carlo results or successful certification of similar vehicles. Cars which pass the Monte Carlo often need improved emission control hardware to do so, and in such cases these technological improvements are all costed in.

Both GM and Ford exhibit no cost differential between compliance with a 3.4 and a 7.0 g/mile CO standard. EPA did not find an increase in cost for GM's 4.9 liter engine to achieve. 3.4 CO in 1981 or 1982. This is due to the fact that the system GM has designated as their 7.0 CO system is the same as the system which has passed 1981 certification (vehicle 1260) and the modified Monte Carlo analysis (vehicle 1264). Ford's 1.3 and 1.6 liter engines also display no cost differential between 3.4 and 7.0 CO because the cost issue does not arise for engine sizes which are labeled "fail" (1981) or "no data" (1982) in the Monte Carlo analysis.

Manufacturer's Cost Estimates

Neither GM nor Ford presented manufacturers' estimates of cost to the consumer of compliance with the 3.4 CO standard over cost of meeting 7.0 CO. GM claimed that they could not achieve 3.4 CO with their 4.9 liter engine and therefore did not differentiate between 3.4 and 7.0 system costs [1 at 197]. Ford estimated that the cost of complying with the 1981 statutory passenger car emission standards would add approximately $400 (retail price equivalent) to the cost of an average car relative to the average cost of meeting the 1977 model year standard.

They qualified that statement by adding that it is difficult to make a like comparison specifically for the 1.3/1.6 engines because both of these engines are new for 1981 [2 at IIB]. The 1977 CO standard was 15 g/mile. No estimate was given by Ford for the cost differential between 3.4 and 7.0 CO.

VII. Driveability

The technological feasibility of meeting the 1981–1982 emission standards is, in part, determined by the applicants ability to maintain acceptable driveability while attaining these standards.

a. GM—While maintaining that they are incapable of meeting the 1981–1982 emission standards, GM has not indicated that a waiver would be necessary for the turbocharged 4.9 liter engine family to maintain acceptable driveability. No driveability data were submitted for this engine family by GM. GM representatives stated at the public hearing that they cannot assess the effect on driveability of going from a 7.0 to a 3.4 g/mi CO standard because they cannot achieve the 3.4 CO level as yet [1 at 247]. Therefore, driveability is not one of the determining factors in assessing the ability of GM to comply with a 3.4 g/mi CO standard.

b. Ford—Ford has submitted driveability data for their 1.6 liter engine family [10 at attachment]. The data shows tailpipe emissions and driveability ratings of 4K development vehicles for 33 of the 97 tests run. The remaining 64 tests are presented with their corresponding emission results, but lack driveability ratings. Eight of the 33 tests for which driveability was

assessed were run with vehicles equipped with a manual transmission. The average CO level for these tests is 1.52 g/mile with an average driveability rating of 4.56 (borderline to acceptable driveability as assessed by Ford). The remaining 25 tests for which driveability was assessed were run with vehicles equipped with an automatic transmission. The average CO level for these tests is 3.12 g/mile with an average driveability rating of 4.98 (borderline to acceptable driveability as assessed by Ford). It is important to note, however, that this represents only 28% of tests run on vehicles equipped with an automatic transmission.

No driveability data were submitted for 1.3 liter engine family vehicles.

Initially, Ford planned to use a Holley 5200 carburetor mounted on the transverse 1.6 liter engine. Driveability proved to be unsatisfactory with this carburetor due specifically to what Ford termed "hesitation under cornering conditions." They then decided to go with a non-feedback version of the Weber 740 carburetor for the 1.6 liter engine. It was judged by Ford that the emission standards of .41 HC, 3.4 CO, 1.0 NO_x could be met, and that it would be more cost effective, to alter the combustion chamber design to improve combustion burn rate rather than switch to feedback carburetion [2 at IIIA].

Ford representatives testified at the March 5, 1980 High Altitude Emission Standards hearing that they plan to convert their six cylinder California engines from open to closed loop during the 1981 model year to improve cold and hot start driveability with these vehicles [11 at 174]. The EPA staff believes that the use of feedback carburetion on the 1.6 liter engine, though calibrated for the Federal CO standard, could improve its driveability also.

Ford reports borderline to unacceptable driveability has been experienced in all of their testing of vehicles using 1.6 liter engines which are calibrated for 3.4 CO [2 at IIIA]. In order to achieve low CO emissions in certification Ford calibrated their vehicles for minimum enrichment and maximum catalyst efficiency. They also claim that these engines cannot tolerate air/fuel ratios much leaner than stoichiometry without requiring higher EGR rates (for NO_x control) causing significant driveability degradation [2 at IIIA].

Ford has proposed secondary air revisions (decreased secondary air) and air/fuel ratio enrichment during both heavy and light load conditions to minimize catalyst temperatures and improve vehicle driveability at the expense of CO conversion efficiency [2 at IIIA]. This strategy assumes a 7.0 g/mile CO standard.

Ford indicated that 4K development data are most useful in determining how calibration changes affect the tradeoff between gaseous emissions and driveability [2 at IIIA]. A plot of CO versus driveability from the 4K development vehicle data submitted by Ford [10 at attachment] is provided in figure VII–1. There appears to be a direct relationship between CO and driveability as evaluated by Ford. A least squares line was fitted through the manual and the automatic transmission vehicles' data points. Since vehicle and emission control system descriptions were not provided by Ford, the EPA technical staff is not certain how to interpret the data. Based on the information submitted by Ford, we can not conclude that driveability is a critical issue.

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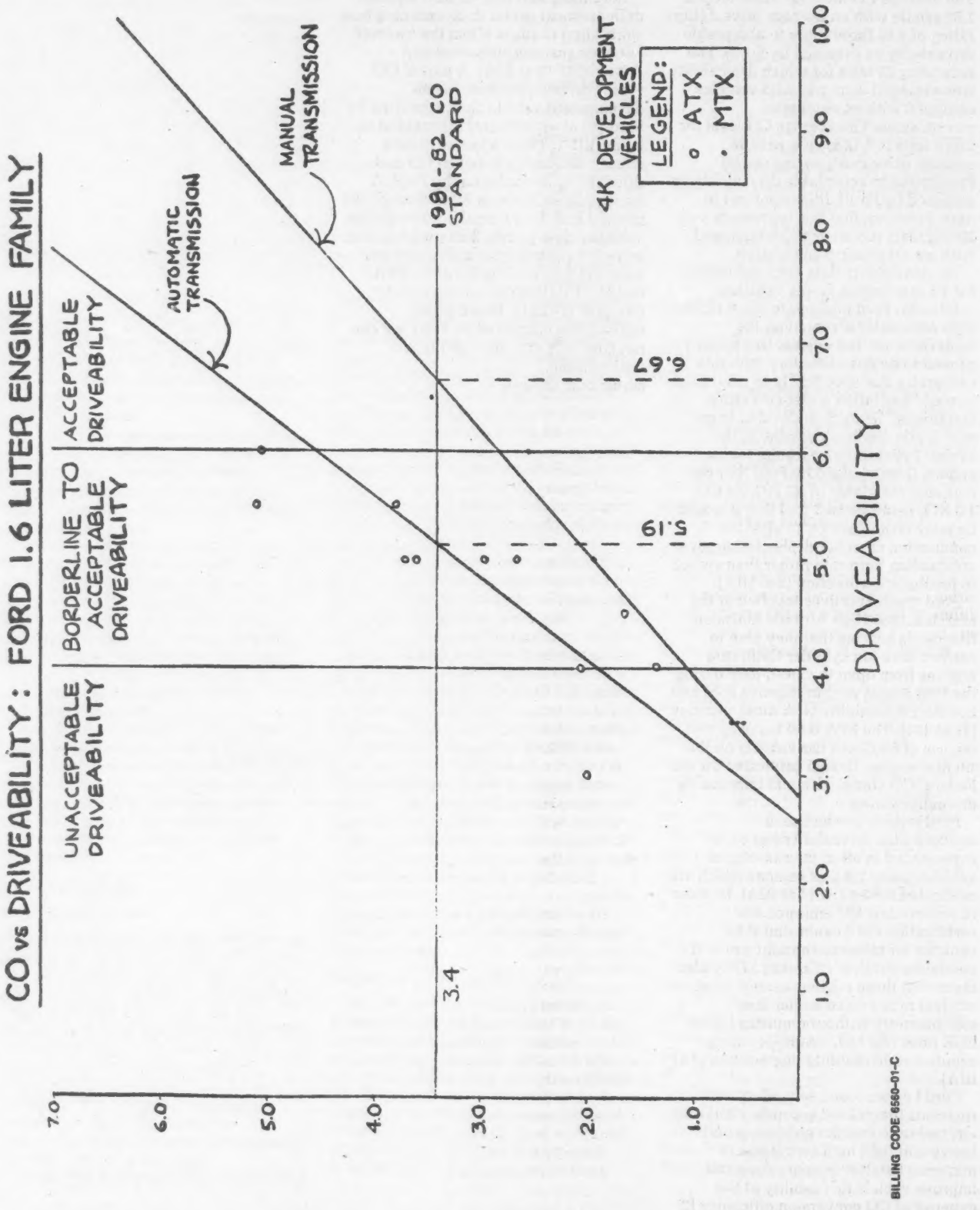
Figure VII-1



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VIII. Fuel Economy

Ford

Ford's CO waiver request did not address the effects of a 3.4 versus a 7.0 CO standard on the fuel economy of their 1.3L and 1.6L engines. Ford described a situation wherein if they could not meet the 3.4 CO standard and they were denied a CO waiver, the effect on their CAFE would cause severe disruptions [1 at IIA]. In testimony given at the first CO waiver hearing Ford said the following:

> The direct driveability and fuel economy effects of attempting to meet a 3.4 gram per mile CO standard are expected to be minimal because the changes primarily affect exhaust after-treatment devices. The changes in calibration and componentry individually cause some changes in fuel economy. but in combination, the improvement and losses are a near wash. [12 at 209]

Based on the above testimony, and because Ford did not establish that compliance with a 3.4 g/mi CO standard would have a deleterious affect on the fuel economy of the 1.3L/1.6L engines, EPA can only conclude that fuel economy is not a crucial issue in the determination of technical feasibility.

General Motors—GM testimony indicates that they are not claiming a fuel economy penalty for the 4.9 liter turbocharged engine as a result of the difference between a 7.0 CO standard and a 3.4 CO standard because they do not believe that they have an emission control system capable of meeting a 3.4 CO standard [1 at 196–197].

Investigation by the technical staff between the turbo and non-turbocharged durability vehicles, V,I. numbers 1260 and 1245 respectively, show that both vehicles meet the 1981 emission standards, and that the naturally aspirated vehicle has better fuel economy. Data provided by GM show the naturally aspirated version of the 4.9 L engine has a fuel economy benefit of 1.4 MPG_u 0.5 MPG_h and 1.2 MPG_c over the turbocharged 4.9 L engine [7 at 10]. Both of these engines' fuel economies are below the 1981 and 1982 CAFE standards of 22 and 24 MPG_c. The above comparison between the turbocharged and naturally aspriated vehicles is a comparison at constant engine displacement. Another comparison which could be made is a comparison at constant power output. G.M. did not supply any data at constant power; however, it is anticipated that some fuel economy benefits could be shown for the turbocharged 4.9 L engine as compared to using a larger displacement, naturally aspriated engine of equivalent power.

In summary, the fuel economy differential between 3.4 and 7.0 CO standards is not an issue for General Motors because the system which they considered to be a 7.0 CO system has successfully certified at 3.4 CO.

IX. Lead time Considerations

General Motors.

Several options are avaialbe in the 1981–82 model years for GM to investigate to further reduce CO emissions below the 3..4 g/mile standard for the turbocharged 4.9 liter engine family.

In their February 25, 1980 submission, GM stated that steady-state and dynomometer tests taken in mid-December 1979 showed potential for CO conversion efficiency gains for the turbocharged 4.9 liter V–8 by using much higher proportional steps and integration rates for fuel control than those customarily used in naturally aspirated V–8 engines [7 at 8). Vehicle 97134 showed a 48% decrease in CO emissions as a result of modified fuel control, and GM stated that certification durability car No. 1264 has already incorporated this technology. In order to meet their scheduled start of 1981 production, GM claims that lead time considerations require them to provide final electronic control unit calibrations to their supplier division by Mid-May 1980 [1 at 188]. Vehicle 1264 will be complete or nearly complete in certification by then to let GM choose between this newer air/fuel ratio control strategy and the strategy used on their other successful certification vehicle. Another option available to GM in both 1981 and 1982, is to replace the 4.9 liter turbo with the 4.9 liter naturally aspirated engine. GM has confirmed that there are no lead time problems associated with this change for 1981 or 1982, and that there is sufficient capacity in their naturally aspirated engine facilities to do so [1 at 205] [7 at 4].

Alternatives available to GM in 1982 include the use of stainless steal exhaust manifolds, investigation of higher volume monolithic catalysts, increased catalyst noble metal content, and additional calibration changes.

Vehicle 97135 demonstrated a 44 percent decrease in CO emissions using a tubular stainless steel exhaust manifold on the left bank when compared to the conventional cast iron left hand exhaust manifold. This type of manifold has been designed, purchased and released for the left bank of the 1982 MY 4.9 liter turbocharged V–8 engine [1 at 243, 245] [7 at 9]. GM has also actively instituted a program with their turbocharger supplier to go to a fabricated turbo housing to further reduce the thermal inertia of that system [1 at 247].

Representatives of GM explained that although they should be investigated for 1982, larger volume monolithic converters were excluded from 1981 consideration due to lack of data [1 at 223]. They indicated to EPA that not only do the monoliths weigh considerably less [7 at 6], but they also reach a higher converter efficiency quicker than the dual bed pelleted converter at volumes of 170 to 250 cubic inches [1 at 219].

Another area that will be looked at for 1982 is increased noble metal loading. GM has reported some gains in CO control from more heavily loaded catalysts [1 at 239–40].

Additional emission control system improvements were discussed by GM; however, the need for additional improvements is now questionable due to the success of current engine families in 1981 model year certification.

Ford. One of the obstacles preventing Ford from meeting the 3.4 g/mile CO standard in 1981 is their claim that leadtime is not available to apply appropriate new technology on the 1.3 and 1.6 engine family vehicles. Specific technology which may be at issue in Ford's attempts to certify these vehicles are (1) the use of feedback carburetors or throttle body injection, (2) the development of electronic fuel injection, and (3) revisions to the air management system.

When the hardware selection process was made, Ford judged that feedback carburetion would not be necessary for the 1.3 and 1.6 liter engines because they believed they could achieve adequate air fuel ratio control near stoichiometry with the non-feedback Holley-Weber 740 carburetor [1 at 131] [2 at III C–20].

It was also felt that the non-feedback carburetor system, in addition to being the most cost effective alternative, could control emissions from engines of this size without the use of electronics [1 at 109]. Ford has had produced experience with feedback control on their 2.3 liter California engine since 1978 but does not have any data for this specific application [1 at 111]. Representatives at the public hearing estimated that if Ford were to put a feedback carburetor on the 1.3/1.6 liter engine, they would be unable to do so until job one, 1983 [1 at 138]. Ford has, however, submitted other information to EPA indicating that feedback carburetors are under consideration for use in 1982 on Ford's small four cylinder engines as part of their high altitude compliance plan for passenger cars [18 at attachment II].

What Ford would rather do, as far as identifying a high confidence system for meeting the statutory standards, is go to a system using electronic fuel injection [1 at 138]. They are programming an electronic fuel injected 1.6 liter engine for production in 1982 1/2, though at the present time, they do not believe that it would be cost effective to pursue a central fuel injection system for a four cylinder engine [1 at 112].

One of the main problems reported with the 1.3/1.6 liter engine is thermal degradation of the catalyst. Ford stated at the hearing that it is their intent to modify their secondary air delivery schedule to achieve the catalyst efficiency that they have demonstrated on all of their other products [1 at 119]. The principal air controls used to manage air for CO control is a combination bypass and air diverter valve. The valve, when interfaced by an EEC or MCU control module or in this case a temperature sensing device, will divert secondary air upstream into the exhaust manifold on cold-start or open-loop modes for three-way catalyst applications. After a time or temperature chosen to correspond to catalyst light-off, the air may be switched downstream between the catalyst beds or vented, depending on the specific model strategy desired. A variation of this valve will divert a portion of the air flow upstream and the balance downstream as required on particular modes. Ford indicated in their application that for the 1981/82 model years, a secondary air management system, such as described above, may be used on the 1.3 and 1.6 liter engine families [2 at III C–12, 13]. They also stated that from past model usage of the basic secondary air system, such factors as component durability, reliability, and other factors were known and only refinements to components or control strategy were required. EPA concludes that there are no leadtime difficulties in updating the current secondary air strategy for the 1981 model year and that additional flexibility could be attained for later use if the primary logic control system is converted to an EEC or MCU control module. With the updated secondary air system the probability of attaining 3.4 is very low although the likelihood of a more durable catalyst is increased.

Solutions which the technical staff believes could be investigated for 1982 are:

- Closed loop air/fuel metering
- Gulp valves for deceleration HC and CO control
- Exhaust port liners
- Increased rhodium in the 3-way catalyst
- Increased 3-way and oxidation catalyst volumes

X. References

1. *Transcript of Proceeding, U.S. Environmental Protection Agency, In the Matter of: Public Hearings on Applications for Waiver of the 1981 and 1982 CO Emission Standard for Light Duty Vehicles* February 12, 1980, Acme Reporting Company.

2. *Application for Waiver of 1981 and 1982 Carbon Monoxide Emission Standard,* Ford Motor Company, February 1980.

3. *Supplemental Information for Application for Waiver of 1981 and 1982 Carbon Monoxide Emission Standard,* Ford Motor Company, February 1980.

4. Letter from Ms. H. O. Petrauskas (Ford) to Mr. C. N. Freed (EPA) dated March 19, 1980.

5. Letter from Ms. H. O. Petrauskas (Ford) to Mr. C. N. Freed (EPA) dated March 25, 1980.

6. *General Motors Application for Waiver of 1981 and 1982 Carbon Monoxide Emission Standard (Turbocharged 4.9 Liter Engine Family),* February 8, 1980.

7. Attachment to letter from Mr. T. M. Fisher (GM) to Mr. Charles N. Freed (EPA) dated Feb. 25, 1980. Attachment is entitled "General Motors Response to Questions Raised by the Environmental Protection Agency Panel During General Motors Testimony at the Carbon Monoxide Waiver Hearing of February 12, 1980".

8. Letter from Mr. T. M. Fisher (GM) to Mr. Robert Wagner (EPA) dated March 18, 1980.

9. Letter from Mr. K. M. Brown (Ford) to Mr. Robert Wagner (EPA) dated April 2, 1980.

10. Letter from Mr. K. M. Brown (Ford) to Mr. Robert Wagner (EPA) dated March 31, 1980.

11. *Transcript of Proceeding, U.S. Environmental Protection Agency Region 8, In the Matter of: Proposed High Altitude Emission Standards for 1982 and 1983 Passenger Cars and Light Duty Trucks, and Proposed High Altitude Performance Adjustment Regulations, and High Altitude Emission Standards for 1984 and Beyond Passenger Cars and Light Duty Trucks,* March 5, 1980, reported by Mr. Holman E. Milks.

12. *Transcript of Proceeding—Environmental Protection Agency—In the Matter of: 1981 and 1982 Emission of Carbon Monoxide Waiver Hearings* dated July 10, 1979, Acme Reporting Company.

13. Leroy H. Lindgren, *Cost Estimations for Emission Control Related Component-Systems and Cost Methodology Description* EPA Pub. #460/3–78–002, March 1978.

14. *Federal Register,* Vol. 44, No. 179, September 13, 1979.

15. *Federal Register,* Vol. 44, No. 223, December 3, 1979.

16. *Federal Register,* Vol. 45, No. 22, January 31, 1980.

17. *Federal Register,* Vol. 45, No. 55, March 19, 1980.

18. Letter and attachments from D. A. Jensen (Ford) to Mr. Michael P. Walsh (EPA), April 30, 1980.

19. C. D. Falk and J. J. Mooney, "Three-Way Conversion Catalysts: Effect of Closed-Loop Feed-Back Control and Other Parameters on Catalyst Efficiency", SAE paper 800462, February 1980.

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